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United States Patent and Trademark Office

June 27, 2005

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APPLICATION NUMBER: *60/552,018*
FILING DATE: *March 09, 2004*
RELATED PCT APPLICATION NUMBER: *PCT/US05/07708*

Certified by

Jon W. Dudas

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PTO/SB/16 (01-04)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. ER 906190112 US

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
PETER DEPEW	FISET	LOUDONVILLE, NY

Additional inventors are being named on the _____ *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

SKIN TANNING AND LIGHT THERAPY INCORPORATING LIGHT EMITTING DEVICES AND COOLING FLUID

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ Customer Number:

OR

☑ Firm or Individual Name	PETER DEPEW FISET				
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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 62 ☐ CD(s), Number _____

☑ Drawing(s) *Number of Sheets* 18 ☐ Other (specify) _____

☐ Application Data Sheet. See 37 CFR 1.76

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☑ Applicant claims small entity status. See 37 CFR 1.27.

☑ A check or money order is enclosed to cover the filing fees.

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FILING FEE Amount ($): 80

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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Respectfully submitted,

SIGNATURE Peter Depew Fiset

TYPED or PRINTED NAME PETER DEPEW FISET

TELEPHONE 518.449.1076

Date MARCH 9, 2004

REGISTRATION NO. _____ *(if appropriate)*

Docket Number: _____

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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Docket Number	

INVENTOR(S)/APPLICANT(S)		
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Number 1 of 1

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FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☒ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 80

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	PETER DEPEW FISET
Examiner Name	
Art Unit	
Attorney Docket No.	

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The Director is authorized to: *(check all that apply)*

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	80

SUBTOTAL (1) ($) 80

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

		Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X	=	
Independent Claims		- 3** =		X	=	
Multiple Dependent					=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

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SUBTOTAL (3) ($)

SUBMITTED BY

(Complete *(if applicable)*)

Name (Print/Type)	PETER DEPEW FISET	Registration No. (Attorney/Agent)		Telephone	518.4491076
Signature	Peter Depew Fiset			Date	MARCH 9, 2004

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Inventor: Peter Depew Fiset Date: 03/09/2004
I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date-MM/DD/YYYY)
Witness: Robert Kaehler Date: 3/9/2004
Witness: Chris Gessler Date: 3/9/2004

Provisional Patent Application of

Peter Depew Fiset

for

TITLE: SKIN TANNING AND LIGHT THERAPY INCORPORATING LIGHT EMITING DEVICES AND COOLING FLUID

CROSS REFERENCE TO RELATED APPLICATIONS: 10/714,824

FEDERALLY SPONSORED RESEARCH: None.

SEQUENCE LISTING: None.

BACKGROUND OF THE INVENTION -- FIELD OF INVENTION

This invention relates to the field of lighting including but not limited to solid state light emitting devices (LEDs) for use in phototherapies including but not limited to indoor tanning. Further, this invention relates to the field of environmental control systems including but not limited to temperature control systems for use with cooling electronics including but not limited to cooling LEDs. Further this invention relates to the field of thermodynamics including but not limited to heat engines for use in converting heat power into work power useful in lighting applications including but not limited to phototherapy, and to general purpose lighting.

BACKGROUND OF THE INVENTION

For the useful purpose of this application, the entire set of industries that implement the useful and purposeful exposure of light

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 2

to cellular tissue are hereby referred to as the phototherapy industry. The set of all procedures that implement the controlled exposure of light to cellular tissue is hereby referred to as phototherapy. The indoor tanning industry is a subset of the phototherapy industry. Likewise, indoor tanning procedures are a subset of phototherapy procedures. Indoor indoor tanning makes use of the observed physiological behavior of skin of specific types to exposure with ultraviolet (UV) light of specific wavelengths. The biochemical reactions and photobiological mechanisms are partially known, the industry is investigating more theories continuously. Industries that are a subset of the phototherapy industry include but are not limited to indoor tanning, dermatology, dentistry, dental care, and internal medicine. Indoor indoor tanning categorizes skin with differing levels of pigmentation as Type I, Type II, Type III, Type IV, Type V, wherein Type I has the least amount melanin melanin and Type V has the greatest melanin content.

Within the class of lighting devices is the subclass of solid state light emitting devices. In this document any solid state lighting device is referred herein as a LED or a plurality of light emitting devices as LEDs. LED devices have at least one active portion with which photons are produced and emitted. Within this document various types of active portions are hereby referred to as active junctions.

Within the class of LEDs is the subclass known as light emitting diodes. Light emitting diodes contain at least one active junction known in the literature as the semiconductor junction. For the purpose of this document all photon generating potions of the light emitting diode are referred to as active junctions.

The LED subclass includes but is not limited to the following devices referred to in the literature and prior art as light emitting diodes, semiconductor light emitting diodes, polymer light emitting devices, organic light emitting devices, multiple quantum well light emitting devices, quantum dot light emitting devices, quantum dot light converting devices. Light emitting diodes incorporating quantum dots and also considered solid state lighting devices and in particular are themselves light emitting diodes.

Quantum dot devices are in general semiconductor crystals known as

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Witness: Laura Geissler Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 3

luminous nanocrystals which exhibit a quantum behavior which is dependent on the size of the crystal and the crystal environmental conditions within proximity to the quantum dot. Quantum dot composition includes but is not limited to various molar concentrations of the elements contained in zinc oxide (ZnO), cadmium sulfide (CdS), Cadmium Selenium (CdSe), Silicon (Si), Lead Sulfide (PbS), Zinc Sulfide (ZnS).

Historically, the phototherapy industry provisions UV light from fluorescent light bulbs comprising glass enclosures filled with mercury vapor and phosphors. In general, mercury vapor based bulbs are classified as high pressure mercury vapor bulbs and low pressure mercury vapor bulbs. Low pressure mercury vapor bulbs are commonly referred to as fluorescent light bulbs. A typical form factor for a low pressure mercury vapor bulb is a glass tube 1.5 inch diameter and 72 inches long. Within a powered mercury vapor tube, electrons are accelerated by an electric potential applied from the negatively charged end of the tube toward the positively charged end of the tube and in so doing collide with mercury atoms in a vapor phase causing the electrons of the mercury atom to enter a high energy state and subsequently emit a photons in one of a few discrete narrow wavelengths including but not limited to a approximately 254 nm wavelength. The photons of approximately 254 nm emitted from the mercury vapor inside the tube interact with a phosphor film on the inside surface of the glass with subsequent wavelength conversion to a wide range of wavelengths including but not limited to approximately 290 nm - 400 nm in the case of UV mercury vapor bulbs designed for indoor tanning.

With the recent advent of UV light emitting diodes it is now possible to provision phototherapies using solid state lighting. All of the providers, including but limited to dental providers, medical providers and indoor tanning providers, within the phototherapy industry with various procedures using specific wavelengths have an opportunity to implement solid state lighting apparatus as an alternate light source for provisioning light in arbitrary phototherapy procedures. In addition, phototherapies for which LEDs are useful include but are not limited to teeth whitening phototherapy, hair growth assistance phototherapy, and pattern indoor tanning.

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Witness: Chad Dressler Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 4

One of the many advantages of LED technology is the longer useful life relative to conventional mercury vapor bulbs. The useful life of an LED varies with technology type. As an example the UV light emitting diode part number UV-395-TO92, from Bivar Incorporated (Irvine, CA, USA), has a rated life of 10, 000 hours compared to approximately 400 hours of useful life for a common T12 type low pressure mercury vapor based UV indoor tanning fluorescent bulb.

Within this document the term "UV LED" refers to all UV light emitting devices with the exception of mercury vapor bulbs. The term UV LED includes but is not limited to UV light emitting diodes, and to quantum dots. The term UV refers to the useful range of light for a particular phototherapy including but not limited to the range useful for indoor tanning skin between 400 nm and 300 nm, and the range useful for treating patients with the lupus disease between 400 nm and 350 nm. Other useful ranges of light are referred to as UV. The terms UVA, UVB and UVC refer to ranges of wavelengths of light which are context specific, in other words the definition of UV, UVA, UVB, and UVC are defined by the intended use.

A disadvantage of solid state lighting is the relatively high initial cost of an equivalent light source. The cost of solid state lighting is expected to decrease with an increase in volume expected in the future. The objects and methods of the present invention includes combinations of useful purposes including but not limited to the useful purposes of decreased cost for similar light provisioning by overdriving said LEDs, the useful purpose of decreasing variation in wavelength range of provisioned light, and the useful purpose of stability of provisioning light which reduces the need for expensive calibration and testing of light source to prove required specifications and consistency between uses.

The method of overdriving LEDs decrease the useful life of an LED and decreases the number of LEDs required to provision light of any given flux density, wherein the term overdriving refers to electric current levels greater than manufacturer maximum specification. The method of cooling said LEDs utilized within the present invention increases the useful life of said LEDs which compensates for the loss of useful life due to overdriving.

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Witness: Robert Kuehler Date: 3/9/2004
Witness: Paul Kessler Date: 3/12/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 5

A further embodiment of the present invention incorporates novel combinations of methods including but not limited to overdriving, and cooling, for the useful purpose of provisioning light with properties including but not limited to lower fixed costs, lower variable costs, and more consistent wavelength ranges.

LEDs that are not perfectly efficient tend to produce heat locally within the active junction of the LED as a result of the inefficiencies of the conversion of work energy, usually in the form of electric power, into energy in the form light. As heat energy accumulates the temperature of the active junction mass increases. It is useful to implement objects and methods of heat transfer to maintain the LED active junction temperature within minimum and maximum values at a given pressure in order to achieve a useful LED life expectancy. Heat transfer occurs in stages, wherein the primary heat transfer stage is in immediate proximity to the heat source, and wherein the final heat transfer stage is immediate proximity to the heat sink. The present invention makes novel use of heat transfer mechanisms in the objects and methods of the invention as related to practical applications including but not limited to LED cooling, and to LED cogeneration, wherein cogeneration refers to the combined creation of light power, heat power and electric power. The primary heat transfer stage is also referred to as the first heat transfer stage within this document. Another term that can be defined for use in this document is regeneration, wherein regeneration refers to the method of recycling power from one form to another and resulting in a form the power was originally introduced to the system. For example, in the case of light provisioning the form of energy most commonly used as the input power is electric power. The electric power is applied to the light provisioning means such as an LED to convert the electric power to the preferred light power with a certain efficiency and the remainder as heat power. The entire heat power flux could be used to suit useful purposes such as heating a building or the heat power could be directed to a heat power to work power conversion means with a maximum thermodynamic conversion efficiency with separate outputs of work power, of lower entropy values, and a heat power of higher entropy values. The higher the entropy values associated with the heat power the lower the probability of further conversion of heat power to work power. There may be multi-stages of heat power to work power conversion which ultimately requires a heat sink to the ambient

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Witness: Robert Kaehler Date: 3/9/2004
Witness: Chris Gessaler Date: 3/9/2004

environment. The work power conversion can then be reapplied to the original purpose of create light, which for the purpose of this document is referred to as work power regeneration. The term work power includes but is not limited to electric power, hydraulic power, and to mechanical motive power. The term cogeneration refers to a process which makes use of chemical power inputs and outputs useful work power and useful heat power. Useful heat power refers to a heat power of relatively high entropy values capable of a useful purpose as compared to heat power of low entropy values which ultimately serves a purpose of heating the ambient environment. Therefore, cogeneration is applicable in this novel use of combined methods is chemical power were the input to the light provisioning means with outputs of light power and heat power.

The objects and methods of air cooling electronics is known in the prior art and will herein be referred to as known air cooling within this document. Known air cooling refers to the use of air as the cooling fluid used to transfer heat from the objects being cooled to the the final heat sink which is the ambient environment.

Heat power transferred to the ambient environment has the highest increase in entropy values and is thus most useless form of heat power. The final stage of heat transfer to the ambient environment is an application of the method of known air cooling.

The present invention combines known cooling methods with novel objects and novel methods of cooling electronics and in particular LEDs. The novel objects and methods includes immersion cooling methods used in combination with LEDs and a transparent lens. The novel objects and methods includes immersion cooling used in combination with LEDs, a refrigeration means, and a transparent lens means.

An embodiment of the present invention makes novel uses of known air cooling as the final stage of a multiple stage heat transfer method from powered LED components to the ambient environment.

In the prior art, air is used as a cooling fluid in the known air cooling method. However, air is one of many suitable compound useful as said cooling fluid for use with the novel objects and novel methods of the present invention. The use of air as said cooling fluid does

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Witness: Linus Gerstner Date: 3/9/2004

not imply that the present invention is limited to the known air cooling method. The novelty of the present invention is found in the useful combination of the known method of known air cooling with additional objects and methods as described in this document. The present invention incorporates known air cooling as a useful final stage of heat transfer from said cooling fluid incorporated within the object of the present invention to the ambient environment. Known air cooling is used in combination with the present invention which incorporates said cooling fluid, wherein said cooling fluid composition includes but is not limited to air, compositions of water, compositions of perfluorocarbon, and compositions of silicone oil wherein, known air cooling is useful as the final stage of heat transfer from said cooling fluid to the ambient environment. In other words, the air used in the final stage of cooling referred to as known air cooling.

The objects and methods of water cooling electronics described in prior art, will be referred to as known water cooling within this document. Heat power transferred to the ambient environment has the highest increase in entropy values and is thus most useless form of heat power. The final stage of heat transfer to the ambient environment is an application of the method of known water cooling.

A further embodiment of the present invention incorporates known water cooling as the final stage of a multiple stage heat transfer method from the LED components to the ambient environment. Known water cooling refers to the use of water as the cooling fluid used to transfer heat from the objects being cooled to the ambient environment, where the ambient environment is the final heat sink. In the prior art water is used as a cooling fluid in the known water cooling method. However, water is one of many suitable compounds useful as said cooling fluid for use with the novel objects and novel methods of the present invention. The use of water as said cooling fluid does not imply that the present invention is limited to the well known known water cooling method. The novelty of the present invention is found in the useful combination of the known method of known water cooling with additional objects and methods as described in this document. The present invention incorporates known water cooling as a useful final stage of heat transfer from said cooling fluid incorporated within the object of the present invention to the ambient

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Witness: Robert Kuehler Date: 3/2/2004
Witness: Date: 3/2/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 8

environment. Known water cooling is used in combination with the present invention which incorporates said cooling fluid including but not limited to compositions of air, compositions of water, compositions of perfluorocarbon, and compositions of silicone oil wherein, known water cooling is useful as the final stage of heat transfer from said cooling fluid to the ambient environment. In other words, the water used in the final stage of cooling referred to as known water cooling.

A further embodiment of the present invention incorporates combinations of known water cooling and known air cooling as the final stage of the heat transfer from the initiating heat source including but not limited to the active junction of LED components, to the final heat sink which normally is the ambient environment.

The current solid state lighting technology is primarily air cooled, with conduction as the major heat transport mechanism from the LED die through the enclosure, and in some cases a solid epoxy encapsulant.

Some types of solid state lighting, including but not limited to metal can packaged light emitting diodes, are packaged in hermetically sealed metal can enclosures incorporating inert gases with at least one wall incorporating a transparent lens, wherein the inert gases include include but are not limited to combinations of the elements Nitrogen and Helium. Within the LED enclosure which allows natural convection to reduce the thermal resistance. The natural convection within a metal can packaged light emitting diode, is less effective at heat transfer than conduction through the metal can package from the surface of the light emitting diode. It is an object and method of the present invention to increase the effectiveness of heat transfer from light emitting diodes by introducing liquids as the cooling fluid, and by introducing forced convection to the heat transfer mode near the active junction of the light emitting diode.

The novel objects and method of the present invention include but is not limited to environmental control means for LEDs, and in particular the novel objects and methods of environmental control means for LEDs used in the provisioning of light for phototherapies, incorporated in this invention utilizes a cooling fluid in addition to

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 9

and in combination with known air cooling conduction and convection of air to the ambient. Said environmental control means includes but is not limited to temperature environmental control means, humidity environmental control means, electromagnetic environmental control means, and vibration environmental control means. Said temperature environmental control means includes but is not limited to cooling means, and heating means. Further discussion regarding the advantages and embodiments of the present invention are found in this document which includes other documents included by reference. Said cooling means includes but is not limited to refrigeration means, evaporative cooling means, cryogenic cooling means, active regenerative magnetic refrigerator means, and magnetic refrigeration means.

A further advantage of solid state lighting is the electric power to light power conversion efficiency in applications requiring specific colors in arbitrarily narrow ranges of wavelengths including but not limited to ranges of wavelengths with full width half maximum of approximately 5 nm. The LED is superior at creating a narrow band of wavelength as compared to conventional mercury vapor light bulbs. Mercury vapor light bulbs require phosphors to convert UV emissions to longer wavelength and then subsequent filters to block portions of the wavelength in order to transmit narrow color ranges. The phosphor conversion and the filters used to create arbitrary ranges of wavelengths from the output of mercury vapor bulbs cause a loss of light power which lowers the efficiency of the mercury vapor based light bulbs.

For the purposes of this document solid state lighting includes but is not limited to modified industry standard light bulbs incorporating solid state lighting objects including but not limited to luminous nanocrystals. An example of a novel modified industry standard light bulb includes but not limited to mercury vapor light bulb incorporating zinc oxide nanocrystals for the useful purpose of provisioning an arbitrary range of wavelengths dependent on the size of the incorporated zinc oxide nanocrystals for an arbitrary phototherapy.

Conventional mercury vapor light bulbs suffer from a number of disadvantages including but not limited to short life span, to mercury recycling problems, to high operating temperatures, and to high

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Witness: Dana Kuehler Date: 3/9/2004

operating voltage.

Current solid state lighting technology lasts much longer than phototherapy chamber owners are accustomed to with mercury vapor light bulbs. This causes a sticker shock reaction when a potential customer is considering the change from conventional mercury vapor light bulbs to solid state lighting. The sticker shock experienced by potential buyers will be reduced by incorporating one or more of the methods and the object of the present invention, because of the need to incorporate fewer individual LED components in the LED array in combination with overdriving the LED array and cooling the LED array sufficiently to allow the LED array to exhibit a useful life period that is appropriate for the application. A useful mercury vapor based UV fluorescent bulb life in the indoor tanning applications is considered to be approximately 400 hours. For example, an LED component that under normal operating conditions has a lifetime of 10, 000 total hours would last for more than 9 years at a 30 percent duty cycle in 10 hour salon day. This length of time, 9 years, is more than a typical customer is expected for a given application such as indoor tanning. Therefore a design tradeoff is available and useful in the novel method and novel objects of the present invention to overdrive the LED with more current that the rated maximum thus obtaining more light flux per LED component at the tradeoff of reduced lifetime, whereupon the introduction of refrigeration means is a design tradeoff to increase the useful life of said LED. The useful technique of extending the lifetime of the LED component by cooling the LED so that the active junction temperature is maintained at a low temperature. Wherein said low temperature includes temperatures below ambient when a refrigeration cooling device is incorporated in a useful manner. In general, the active junction temperature should not be lower than is useful, of which an example is the UV light emitting diode manufactured by Bivar, Irvine, California, USA, with a manufacturer minimum operating temperature of minus 25 degrees Celsius at nominal atmospheric pressure. It is not useful to cool the active junction temperature to the point where there is diminishing returns on the additional life of the LED for the cost of additional cooling, for a given LED lifetime. It would not be useful, with exception including but not limited to performance art, and to comedy, to cool said LED beyond the point of economic returns. A useful low active junction temperature allows the light emitting diode type LED to be either

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overdriven with electric current while maintaining the rated life of the LED, or to extend the life of the LED while maintaining electric current under rated maximums. The engineering and marketing design tradeoff relates to the cost of provisioning the advanced cooling means and the cost of the power to cool the LED compared to the reduced cost of the initial LED components and the life of the LED component. LED Manufacturers publish a specify typical minimum and maximum operating conditions for the LED which serves as design goals of the objects and methods of the present invention. A typical maximum operating active junction temperature which allows for a relatively long useful LED life is less than 85 degrees Celsius for a typical light emitting such as the UV light emitting diode labeled Bivar UV-395-TO92.

A further embodiment of the present invention incorporates a selective operating means wherein said selective operating means controls the expected life of said LED with an arbitrary selection on the cooling capacity. A selective operating means is useful for the phototherapy provider to arbitrarily set operating characteristics that maximizes operating variables at the discretion of the provider, and for making use of the available environmental conditions such a differences in cost of electricity during the day and differing costs of cooling throughout the year. Cooling costs vary during the year in climates with temperature fluctuations and the advantage of a cold weather allows for lower costs associated with cooling and higher efficiencies with regard to thermodynamic cycles and cogeneration efficiencies. These environmental conditions can be incorporated into said selective operating means control system with inputs including but not limited to provider preferences, environmental conditions, cost of electricity, and cost of replacement components and output means including but not limited to cooling equipment activity. In almost all commercial cases the default selective operating means is set to maximize is cost per lumen for a fixed standard deviation of emitted wavelength. Variables for this function include but are not limited to initial fixed cost of LED components, to initial fixed cost of cooling components, and to variable cost of power, to variable cost of power per lumen as a function of overdrive current, and to variable cost of life of LED component as a function of active junction temperature.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 12

A further embodiment of the present invention further incorporating a phototherapy chamber with UV opaque walls creating an internal volume the purpose of which used to provide UV light exposure to skin within the phototherapy chamber and UV light protection outside said phototherapy chamber. Said phototherapy chamber is known in the indoor tanning industry as a indoor tanning chamber. Also, said phototherapy chamber is known in the indoor tanning industry as a indoor tanning bed. Also, said phototherapy chamber is known in the phototherapy industry as a phototherapy bed.

Light therapy chamber customers have a predictable negative reaction toward high costs for phototherapy chambers. The cost of LED based phototherapy chambers can be reduced significantly by reducing the number of LED components incorporated within a phototherapy chamber. The number of LED components can be reduced by overdriving the LED components and by cooling said LED components, with the design tradeoffs of increased cost due to incorporated cooling means and decreased life of the LEDs. The present invention incorporates features of known air cooling method in addition to objects and methods useful for improved low temperature cooling of said LED technologies. The improvements found in this present invention made by incorporating advanced cooling means allows for adjustable parameters in terms of cost and LED component life which will be varied to suit the goals of the end user. The method of making this determination of design parameters uses a novel cooling component design algorithm system means with inputs including but not limited to customer expectations for life of LED, estimated or actual price of LEDs at the time of manufacture, estimated or actual price of advanced cooling means at the time of manufacture, cost of electric power, cost of cooling, estimated or actual cost of power, required reliability, average ambient temperature, outdoor air temperature, further, said novel cooling component design algorithm system means with output means to indicate the results of the following variable which include but are not limited to the number of individual LEDs for the array, the size of advanced cooling means, the types of said advanced cooling means. In the cold weather cooling is less expensive when known air cooling final heat sink is outdoors. In addition, electrical power price varies during the day and is referred to as peak periods.

A further embodiment of the present invention incorporates the

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 13

method of controlled manipulation of the conditions of operation of a particular LED subclass will provide a means of varying the nominal wavelength of emitted light. This is useful for obtaining wavelengths other that the nominal wavelength of the LED which would be required for particular phototherapy prescriptions.

In the subclass of LEDs known as light emitting diodes the most common typical wavelength shifting observed is referred to as a red-shift, wherein the typical shift of the wavelength of emitted light is toward longer wavelengths. In light emitting diodes that do not have the benefit of the present invention the temperature of the semiconductor junction gets hotter with increased electric current and the forward voltage drop in the active junction increases resulting in the wavelength shift.

Operating LEDs at lower than normal temperature is useful in shifting the wavelength of the emitted light to a range that is not emitted under normal operating conditions, which includes but is not limited to a controlled shift toward shorter wavelength, herein referred to as a blue-shift. Shifting the emitted output of the LEDs is useful to implement phototherapies that require certain wavelengths that are not normally available from the LEDs.

A further embodiment of the present invention incorporating combinations of LED cooling means and LED heating means useful for controlling the temperature of the LED active junction in an arbitrary dynamic pattern responsive to the output of a phototherapy control algorithm.

A further embodiment of the present invention incorporating wavelength shifting means responsive to the following control mechanisms including but not limited to controlling the duty cycle, controlling the temperature, controlling the electric current. If a wavelength is required that is not available in a nominal range of the LED array, then either a red-shift or a blue-shift of an LED with a wavelength adjacent is required. The choice of red-shift an adjacent LED or blue-shift a second adjacent LED or a combination of both at the same time or sequenced at different times is determined using a novel wavelength shifting control algorithm system with inputs including but not limited to required wavelength, capabilities of

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 14

available LEDs, useful life of wavelength shifted LEDs, cost of power for wavelength shifted LEDs, available cooling requirements, available power sequencing means, and with output means including but not limited to controlling the duty cycle, controlling the LED active junction temperature, controlling the electric current, controlling the forward voltage drop. Further, said wavelength shifting means capable of controlling the the entire array or portions thereof by addressable means.

A further embodiment of the present invention incorporating a plurality of multiple types of LEDs capable of differing nominal wavelength output. A further embodiment of the present invention including a plurality of multiple type of LEDs capable of differing nominal wavelength output, incorporating means to power sets of LEDs independently. The use of a plurality of multiple wavelengths is useful for provisioning multiple application from one of said phototherapy chambers for multiple phototherapies including but not limited to indoor tanning, and to lupus disease therapy, wherein a selection of wavelength is made based upon the condition of the patient. The incorporation of a plurality of multiple set of LEDs of differing wavelength to provision a broad range of wavelengths that would otherwise not be available with a single set of LEDs having the same wavelength. Said plurality of multiple set of LEDs of differing wavelength allows for one phototherapy chamber to be used as a selectively controllable phototherapy chamber for multiple light therapy applications and patient conditions. It is a goal of the present invention to incorporate said useful components to create a general purpose phototherapy chamber for use in multiple phototherapy industries to achieve an economy of scale by bridging the markets of various phototherapy industries with a single light therapy chamber. A further refinement of said generic phototherapy chamber is to incorporate addressable means for individual LEDs. A further refinement of said general purpose phototherapy chamber is to incorporate addressable means for sets of LEDs. A further refinement of said general purpose phototherapy chamber is to incorporate addressable temperature controlling means for individual LEDs. A further refinement of said generic phototherapy chamber is to incorporate addressable temperature controlling means for sets of LEDs.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 15

A further embodiment of the invention incorporating a phototherapy chamber labeling means capable of indicating the current state of the phototherapy chamber meeting or surpassing requirements set forth by regulatory agency of the country of operation including but not limited to operation within the United State of America Food and Drug Administration and Federal Trade Commission, and to operation within the European Union the CE agency.

A further embodiment of the invention incorporating a dynamic phototherapy chamber labeling means capable of dynamically indicating the current state of said general purpose phototherapy chamber meeting or surpassing requirements set forth by the governing regulatory agency of the country of operation including but not limited to operation within the United State of America meeting Food and Drug Administration and Federal Trade Commission regulations, and to operation within the European Union meeting the CE regulations. Further, said dynamic phototherapy chamber labeling means capable of communication and data storage with remote controllers to set current operating state of general purpose phototherapy chamber. Further, said dynamic phototherapy chamber labeling means incorporating a locking mechanism whereby the general purpose phototherapy chamber cannot change function during a session and accepts changes for a useful period of time prior to allowing a patient to enter the general purpose phototherapy chamber, useful for protecting the patient form unauthorized use. Further, said dynamic phototherapy chamber labeling means comprised of visual indicator means including but not limited to video terminal, liquid crystal display terminal, variable mechanical displays. Further, said dynamic phototherapy chamber labeling means comprised combinations of one or more handicap accessible components including but not limited to audible indicator means, and to tactile indicator means, useful for purposes including but not limited to the purpose of protecting sight impaired patients, the purpose of protecting hearing impaired patients, the purpose of assisting hearing impaired general purpose phototherapy chamber administrators provide the proper use of said general purpose phototherapy chamber, and the purpose of assisting sight impaired general purpose phototherapy chamber administrators provide the proper use of said general purpose phototherapy chamber. Wherein said tactile indicator means is comprised of components including but not limited to a mechanical display, and a Braille translator. Wherein said audible indicator

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 16

means is comprised of components including but not limited to a speaker system, an amplifier system with selectable prerecorded messages, selectable multiple language capability.

A further embodiment of the invention incorporating a chamber lockout controller capable of a challenge response control means for useful purposes including but not limited to protecting patients from misuse of said general purpose phototherapy chamber, wherein said challenge response control means in comprised of one or more combinations of components including but not limited to, mechanical locks, electronic locks, audible challenge means, visual challenge means, tactile challenge means, audible response means, visual response means, tactile response means, radio frequency identification means, communications systems. Said audible challenge means comprised of combinations of components including but not limited to a speaker, amplifier, prerecorded messages, and real time operator messages, selectable multiple language capability. Said tactile challenge means comprised of combinations of components including but not limited to a mechanical display, and a Braille translator. Said visual challenge means comprised of combinations of components including but not limited to a video terminal, liquid crystal display terminal, variable mechanical displays. Said audible response means comprised of combinations of components including but not limited to a microphone, and speaker, and voice recognition system. Said tactile response means comprised of combinations of components including but not limited to a keyboard, and to switches. Said visual response means comprised of combinations of components including but not limited to a camera, and visual identification system. Said radio frequency identification means comprised of combinations of components including but not limited to RF ID tags, and radio communications. Further said chamber lockout means responsive to administrative controls useful for purpose including but not limited to metered use, to payment verification, and to fraud prevention, wherein the chamber does not provision phototherapy until all administrative policy requirements are met.

A further embodiment of the invention incorporating workstations, office productivity software, phototherapy management software, equipment to satisfy regulatory requirements, operating policies, communication means, firewalls, wide area networks, office furniture, microcontroller such as the Motorola MC68HC11 microcontroller

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 17

operating control programs to manage equipment and interfaces, identification means including but not limited to radio frequency identification chips embedded in the present invention to determine use and prevent fraudulent use. The method of establishing connections using the computer system and a wide area network to connect to a remote service to download tokens which allow for the metered use and payment of royalties based on the use of the present invention.

A further embodiment of the present invention incorporating a computer system incorporating at least one user input device, at least one wavelength discriminating input means, at least one light power measuring means, at least one central processing unit, at least one memory unit, at least one data storage unit, at least one operator interface, at least one output indicator means, analog to digital converter, digital to analog converter, and at least one power supply for use in recording data in historical trends of use of the LEDs and maintaining LEDs. Wherein a set of logical programs are implemented within said computer system to effectively manage the present invention in selective modes including but not limited to automatically, semi-automatically, and manually. Wherein a specific logical program within said set of logical programs is implemented within said computer system to effectively determine the condition of said present invention. Wherein a second specific logical program within said set of logical programs is implemented within said computer system to effectively determine the condition of separately addressable LED devices. Wherein a second specific logical program within said set of logical programs is implemented within said computer system to on a regular cycle to effectively determine the set of effective LEDs from the set of addressable LED devices by first procedure of briefly turning off all separately addressable LED devices and second procedure of sequentially powering all separately addressable devices one at a time in sequence to determine if the light output is illuminating the patient by reading and recording the value of said light power measuring means. Given a known good LED in an addressable circuit and a known good light power meter a determination of patient illumination may be inferred by power the LED and reading the value of the light measuring means. If the light measuring means is above an arbitrary limit then is can be inferred that the light emitted by the LED is not effectively illuminating the patient. Once a determination of the effective set of addressable LEDs

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is performed and recorded in memory then power is applied the set of effective LEDs for a duration shorter that the typical time a patient's body will move out of the range of the set of effective LEDs location, which is on the order of 0.2 seconds. A LED test method to determine if any LED is known to be good is to power the separately addressable LED without a patient, then a measurement above an arbitrary level indicated that the LED is known to be good. This method of determining known good LED can be subsequently applied to all the other LEDs in the phototherapy chamber separately to calibrate the entire chamber. Further, said LED test method requires the periodic calibration of the light measuring means. Further, said LED test method has a mode of operation that detects if the light measuring means is failing or is failed by incorporating multiple light measuring means and comparing responses from each over a historical trend, where changes relative to one or more light measuring means indicate a potential failure of a given light measuring means. Said light measuring means in comprised of components including but not limited to photovoltaic cells, and photodiodes, and phototransistor. Further, said LED test method may be performed visually by an operator wearing proper protective glasses or may be performed by covering LED array with a translucent fluorescent shield which would transform the light into visible light for easy detection by a chamber operator, in which single LEDs or LED arrays could be tested.

A further embodiment of the present invention incorporating a LED maintenance means comprised of components including but not limited to electrical connectors, to light measuring means, to fasteners, to marking pens, to work orders, to storage, to replacement parts, to paper maintenance logs, and to electronic maintenance logs. The method of using said LED maintenance means including but not limited to using the LED maintenance means on a scheduled basis, using the LED maintenance means only when needed in response to patient indications.

A further embodiment wherein said light power measuring means is a photodetector with a response time of less than 0.000001 seconds which allows for 10, 000 LEDs to be powered on and off separately during said second specific logical program execution sequence of 0.01 seconds. The choice of calibration time to operation time is a duty cycle that depends on factors including but not limited to the

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patient's ability to stay still, the overlap of LED adjacent to powered effective LEDs, wherein a second set of adjacent LEDs to said effective set is also powered with the expectation that the patient will move in a given direction that would include the area illuminated by second set of LED.

A further embodiment of the invention includes a patient orientation prediction means useful to predict the movement of the patient and obtain further efficiencies in the provisioning of light by refining the set of LEDs included LEDs in said second set of adjacent LEDs, wherein said patient orientation prediction means is a logical program executed on a regular interval by said computer system.

A further embodiment of the present invention includes advanced cooling methods including but not limited to immersion cooling, evaporative cooling, and liquid cooling. A further embodiment of the present invention includes advanced cooling means comprised of combinations of one or more components including but not limited to a first cooling fluid, a second cooling fluid, a condensation chamber, an expansion chamber, a refrigerant, a refrigerator, an insulator, a cooling fluid capable of changing phase reversibly from liquid to vapor, a boiling chamber, a transparent lens capable of transmitting light to a useful degree at arbitrary wavelengths, a transparent lens capable of transmitting light to a useful degree at wavelengths between 300 nm and 400 nm.

Immersion cooling is a heat transfer method which increases the heat transfer from electronic components including but not limited to encapsulated chips and bare die. The present invention incorporates a novel use of immersion cooling means in combination with LEDs including but not limited to encapsulated LED and bare LED die. The present invention includes a novel use of a immersion cooling means in combination with LEDs and a cooling control system responsive to inputs including but not limited to estimated active junction temperature, and to measured active junction temperatures. A novel use of a advanced cooling means in combination with LEDs and an active junction temperature control system responsive to inputs including but not limited to estimated active junction temperate, and to actual active junction temperatures, wherein active junction temperatures are

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determined from a photodetector means to measure the wavelength shift effect of the temperature of the active junction. Wherein the wavelength shift effect is calibrated with the prior knowledge of the historical environmental conditions and electric current data stored in said computer and logical program means to calibrate LED operating parameters based on known conditions for a period of inactivity at a particular known ambient temperature to nearly thermal equilibrium where the ambient temperature and the active junction temperature is at equilibrium with known ambient temperature and further to measure the forward voltage drop of the active junction, to measure the wavelength emitted at predetermined electric current levels, and to calculate active junction temperature using an novel active junction temperature algorithm based control system with inputs including but not limited to forward voltage drops, resistively, wavelengths of emitted light and output means including but not limited to duty cycle and electric current waveform within a range of operating conditions that will reach and maintain the desired operating range.

A further embodiment of the present invention incorporating refinements to said active junction temperature control system including but not limited to LED failure detection means, useful for determining failing and failed components and generate reports that would subsequently be used in maintenance procedures on the system incorporating said LED array. Said active junction temperature control system incorporates mechanical attachment means useful for purposes including but not limited to maintaining a permanent attachment, and to remain detachable portable component to be shared among several systems on a scheduled cycle or on an as needed basis. Said attachments means includes but is not limited to connectors, fixtures, fasteners, communication devices, and power supply components.

A further embodiment of the present invention incorporating said LED with light emitting at wavelengths shorter than 400 nm, herein referred to as UV LED, in combination with a cooling fluid reasonably transparent to UV light between the wavelengths of approximately 400 nanometer (nm) and 300 nm, and an enclosure with at least one area of the enclosure having a reasonably UV transparent portion for directing light and a portion of the enclosure acting as a final heat transfer means conductive to the ambient temperature. The choice of wavelengths are based upon the phototherapy requirements, where the choice of

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wavelength less than 400 nm and greater than 300 nm is a choice useful for indoor tanning.

The specific choice of wavelength range varies depending on phototherapy to be provisioned. It is conceivable and expected that specific conditions will require the use of wavelength ranges and subset of wavelength ranges, other than 400 nm to 300 nm. For example, people with the lupus disease are allergic to specific wavelengths which are in general shorter than approximately 340 nm, thus the range of emitted light for a phototherapy session for people with lupus disease would be below 400 nm and above 340 nm.

A further embodiment of the present invention incorporates multiple LEDs of differing wavelength ranges to create a set of wavelengths which is larger than any set LEDs with a single wavelength range.

A further embodiment of the present invention incorporates multiple LEDs of differing adjacent wavelength ranges to create a set of wavelengths which is larger than any set LEDs with a single wavelength range.

A further embodiment of the present invention incorporates multiple LEDs of differing adjacent overlapping wavelength ranges to create a set of wavelengths which is larger than any set LEDs with a single wavelength range.

A further embodiment of the present invention incorporates a method of selecting a wavelength range based on known criteria at the time the wavelength is selected and a novel wavelength selection algorithm means with inputs including but not limited to, the current medical conditions of the patient being treated, patient skin type including but not limited to skin melanin content and skin thickness, the known best available wavelengths for treatment of a given condition, the medical history of the patient being treated, the capabilities of the phototherapy device, the time available for treatment, the treatment cycle, the cost of treatments with varying requirements, and output means to control variables including but not limited to the exposure time, the wavelength and power of emitted light, the sequence from the first set of wavelengths and power of emitted light to a second set of wavelengths and power of emitted light, the further sequencing of

wavelengths and power of emitted light as required to implement an optimum selection for the phototherapy.

The usefulness of the present invention allows the LED to have increased heat transfer which allows operation at a lower active junction temperature for a given current as compared to the prior art which relied on heat transfer through air. The maximum allowable current through each LED will be increased as a result of the increased heat transfer and a lower active junction temperature thereby allowing each LED to produce more photons. The increase in the quantity of emitted photons per LED die allows for a reduction in the total number of LEDs used to create a phototherapy chamber for a desired session time. The reduction in the total number of LEDs lowers the cost of said phototherapy chamber. The reduction in the total number of LEDs lowers the cost of said phototherapy chamber. The mode of operation wherein more electric current is applied to the LED that the rated maximum is referred to as overdriving LEDs. Unless ambient temperatures are relatively low, overdriving said LEDs over long periods requires use of said advanced cooling means resulting in an increase in the total operating power of the present invention.

A further embodiment of the present invention incorporating thermal insulation means that increases the effectiveness of the thermodynamic cycle. Further, a useful arrangement of said thermal insulation is placement in proximity to said micro heat engine so as to approach an adiabatic thermodynamic cycle. Further, use of micrometer and nanometer scale engines that allow for reduced total thermal insulation mass due to the scale of the micro device and the high speed at which the thermodynamic cycle is operated. The faster the cycle the less thermal insulation is required because there is less heat loss. In the extreme the goal of the invention is to achieve a total adiabatic process. A further embodiment of the present invention incorporates thermal insulation including but not limited to silica gels, and to vacuum seals.

A further embodiment of the present invention incorporating thermal insulation means in proximity to cold compressed refrigerant piping means for the useful purpose of keeping said cold compressed refrigerant piping to said LEDs and in particular the heat generating mass of the LED including the active junction of the LED.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 23

Overdriving the LEDs for short periods of time and overdriving the LEDs with short duty cycles over long periods of time will not require a cooling system under normal ambient conditions to achieve a rated life of the LED array. Unfortunately, overdriving the LEDs for short periods of time and overdriving the LEDs with short duty cycles over long periods of time are not useful conditions of operating the LED array for the purposes of many phototherapy procedure including but not limited to indoor tanning, and lupus therapy. An example of a phototherapy requiring additional LEDs is the condition where an area of skin is to be treated and the wavelength of the emitted light is required to be within a range that is only possible to achieve with LEDs that are operated with short duty cycles. A balance between life of the LEDs and cost of the LED replacement includes but is not limited to low active junction temperature, to stable cooling chemistry at the LED interface, and to moderate mechanical vibration.

Given historical trends in cost and prices in similar industries such as the semiconductor industry, it is useful for the purpose of economic predictions to make an assumption due to the similarities between the semiconductor industries and the solid state lighting industries. Based the similar a relationship can be established between the history of the semiconductor industry and the LED industry, and therefore in particular the light emitting diode industry. Given the historical predictable trend of cost and price reductions in the semiconductor industry the cost of LEDs will decrease over time, with intermittent surges in the rate of price changes for short periods due to market conditions including but not limited to spot shortages, and to spot oversupply. Useful economic models predict that the high initial component price will decline as as production increases until the market begins to saturate. The price cycle will repeat for improved replacement components with improved operating characteristics when the improved components become available. Once a component is discontinued the potential exists for the price of the discontinued product to increasing due to undersupply if demand for the discontinued product continues. Algorithms are useful to estimate the future price of LEDs and thus the LED array incorporated in a phototherapy chamber. The price estimates are useful at creating a profitable venture while providing a useful service. The economic balance between the reduced initial fixed cost of said LEDs and the initial increase in fixed cost due to the advanced cooling

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means and the increased variable cost of powering the present invention determines the cooling power requirement of said advanced cooling means which directly affects the number of said LEDs incorporated into a phototherapy chamber. The cooling power capacity of said advanced cooling means is available in discrete configurations which creates a discrete function for cost of said advanced cooling means versus available cooling power of said cooling means. The use of a plurality of cooling means of either similar or varying discrete sizes in combination allows additional data points in the discrete step function. In general it is more likely that one unit of said advanced cooling means will be utilized for each of said phototherapy chambers, however, conditions exist where a set of said advanced cooling means of variable quantity N1 units will provide cooling for a set of said present inventions of variable quantity N2 units occupying a set of said phototherapy chambers of variable quantity N3 units. The optimization of said thermal insulation for use with cooling means. In practice such as in a indoor tanning establishment, cooling capacity is installed in the form of air conditioning as part of a heating ventilation and air conditioning system. The majority of air conditioning is manufactured by Carrier Corp or by Trane Corp. A method of this present invention is the process of locating the air conditioner, installing insulated conduit, insulating through walls, then modifying the air conditioner to direct refrigerant to said LED active junction means.

A further embodiment of the present invention incorporates a thermal storage unit, useful in circumstances where the costs of provisioning, installing, removal, operating and maintaining the cooling means has a combination of advantages which reduces the overall cost of a salon, useful for operating the refrigeration means in a more continuos manner which reduced the stress caused on the refrigerator by frequent start and stops.

The cost of individual said LEDs is also a discrete function of unit 1 with dependencies on manufacturer price variations, availability, volume and frequency of delivery. There is a greater price elasticity, and cost elasticity, in the number of said LEDs incorporated into one of said phototherapy chamber and also within said salon comprised of plurality of said phototherapy chambers, which makes the number of discrete LED components utilized the variable

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 25

dependent of the setting fixed other variables including the refrigeration unit. In other words, given a cooling capacity that may already be in place and available the number of LED is a more flexible variable to determine the most cost effective solution for a given indoor tanning establishment.

A further embodiment of the present invention incorporates a work energy storage unit including but not limited to elevated water storage tanks with reversible pumps, electric motors, electric generator, and batteries with chargers and inverters, wherein work energy storage system is useful in collecting power during low cost periods and supplies power during periods of high cost of power from external utility companies.

A refrigerator is a cooling capacity, ice can be taken from a freezer to into proximity of the LED array and associated heat transfer means to provide a source of low temperature for overdriving said LEDs.

A further embodiment of said solid state light emitting device wherein said solid state light emitting device incorporates a quantum dot or a set of quantum dots comprised of a plurality of said quantum dots of various compositions and sizes, wherein said quantum dots have characteristics useful for a particular phototherapy. For example a phototherapy intending to stimulate Vitamin-D production utilizes a set of wavelengths of light close to 311 nanometers.

A further embodiment of said quantum dot is composed of AlN, GaN, CdS, CdSe and other semiconductor nano-particles.

A further embodiment of the present invention wherein said cooling fluid is operated in a single phase heat transfer mode.

A further embodiment of the present invention wherein said cooling fluid can be operated in a phase change mode. Said phase change mode under optimum conditions reaches a physical condition known as critical heat flux (CHF), wherein CHF is characterized by nucleate boiling at the site of heat generation.

A further embodiment of the present invention incorporating a means

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to convert power in the form of heat transfer into useful work power such as electricity and or mechanical movement such as fluid flow as an integral component of a solid state light for general purpose lighting applications, and in particular for the useful purposes including but not limited to the purpose of indoor tanning and the purpose of phototherapy.

A further embodiment of the present invention wherein said heat transfer object incorporates the use of a heat pipe as a primary heat transfer mechanism to transfer heat using the principle of liquid mass transfer by capillary action of liquids in fibrous solids with hollow portions for vapor mass transport. The new use in combination with LEDs and indoor tanning equipment is a novel mode put forth by this present invention. When said cooling fluid is in direct contact with said LED then it is a useful requirement of said cooling fluid to have specific transparency properties including but not limited to transparency at the wavelengths of emitted light from said LED. A further embodiment of the present invention using said heat pipe is used as a secondary heat transfer stage. Further said heat pipe is used as a heat transfer stage that is not the first stage of cooling. A further embodiment of the present invention incorporating multiple heat pipes, a plurality of heat pipes.

A further embodiment of the present invention incorporating a new use of built-in cooling source means which is an integral component of some phototherapy chambers. It is a useful purpose of this invention to use said built-in cooling unit in a new and useful mode of cooling said solid state light emitting devices in addition to cooling the phototherapy chamber and tanner. The combination of said LED array and said heat power to work power conversion means is a novel object in addition to novelty in the methods of phototherapy applications, including but not limited to indoor tanning, and to lupus disease therapy. A further embodiment of the present invention incorporating the method of modifying built-in cooling source means to insulate and transport cooled refrigerant to the proximity of the LED cooling means, or to the proximity of the active junction of the LED.

This provisional patent application includes the use of light emitting devices used in combination with the previously filed non-provisional patent application 10/714,824. In this provisional patent

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application, the term UV devices refers to, but is not limited to, UV light emitting diodes also know as LEDs. In this provisional patent application, the term UV devices refers to, but is not limited to, UV emitting organic light emitting devices also known as OLEDs.

A further embodiment of the present invention wherein said cooling fluid is optimized for a phototherapy and the process of direct immersion and light transmission, wherein the light transmission properties of the cooling fluid are chosen to be high in transmitting the wavelengths useful in said phototherapy.

A further embodiment of the present invention wherein said cooling fluid is optimized for the requirement of specific phototherapy, including but not limited to indoor tanning and the process of direct immersion and light transmission, wherein the light transmission properties of the cooling fluid are chosen to be high in transmission of the wavelengths useful in said phototherapy and low in transmission of light the is prohibited in said phototherapy, which for indoor tanning the wavelength of transmission would be limited to 400 nm to 300 nm, and for lupus therapy the wavelength of transmission would be limited to 400 nm to 340 nm.

A further embodiment of the present invention incorporating means to change the cooling fluid from a first changeable cooling fluid to a second changeable cooling fluid for the useful purpose of matching the cooling fluid properties to the phototherapy application, as needed when using a UV light source with multiple wavelengths some of which are useful and other wavelengths prohibited, including UV fluorescent mercury vapor bulbs emitting between 400 nm and 300 nm for both lupus therapy and for indoor tanning at differing times by changing the cooling fluid to a cooling fluid with the appropriate wavelength transmission properties.

A further embodiment of the present invention wherein said cooling fluid is optimized for the process of boiling and specifically the mode of boiling referred to as pool boiling and light transmission, wherein the light transmission properties of the cooling fluid are chosen to be high in transmission of the wavelengths useful in said phototherapy and low in transmission of light the is prohibited in said phototherapy.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 28

A further embodiment of the present invention wherein said cooling fluid is optimized for the process of nucleate boiling and light transmission, wherein the light transmission properties of the cooling fluid are chosen to be high in transmission of the wavelengths useful in said phototherapy and low in transmission of light the is prohibited in said phototherapy. The nucleate boiling method is useful because the hottest points of the LED are the places where nucleate boiling occurs and is where the most cooling is needed.

A further embodiment of the present invention wherein said cooling fluid is chosen according to a novel cooling fluid selection algorithm which is useful for optimizing various design criteria. The choice of composition of said cooling fluid is based upon superior stability over periods of time longer than the expected life of said LED component, non-toxic to humans, transparent to light at preferred wavelength ranges including but not limited to the wavelength range between 400 nm to 300 nm, and high heat capacity. Based upon these known design criteria said cooling fluid composition includes but is not limited to perfluorocarbon compounds, to alcohol, and to hydrocarbons. Wherein, said preferred wavelengths between 400 nm and 300 nm produce a useful purpose including but not limited to the useful purpose of indoor tanning, the useful purpose of other phototherapy applications, the useful purposes of dermatologic uses, and the useful purposes of dental uses. Such a candidate compound in known as perfluorocarbon material. The method of choosing said cooling fluid utilizes a novel algorithm and a logic machine with inputs including but not limited to chemical interaction of said cooling fluid with LED, temperature range of said cooling fluid, phase change requirements of said cooling fluid, and calculation means and output means to indicate best choice of cooling fluid for the given inputs.

The prior art does not describe the use of said fluid cooling incorporating ultraviolet (UV) light emitting devices and in particular the prior art does not describe the new use of UV LEDs for indoor tanning incorporating a phototherapy chamber, with the exception of my previous non-provisional patent application 10/714,824. The advantage of perfluorocarbon material used as said cooling fluid is the transmittance for UV light emitting devices.

A further embodiment of the present invention wherein the

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perfluorocarbon cooling fluid has a relatively low atomic mass and preferred to boil at a temperature between 30 and 40 degrees Celsius at 1 atmosphere pressure. An example of such a chemical has boiling point of 29 degrees Celsius, has a molecular weight of 288, is labeled PP50, and is manufactured by F2 Chemicals Ltd (Lee Lane, Lea Town, Nr Preston, PR4 ORZ, UK). The preferred mode of heat transfer using PP50 is phase change heat transfer.

A further embodiment of the present invention wherein the perfluorocarbon cooling fluid has a relatively high molecular weight and preferred to boil above 130 degrees Celsius at 1 atmosphere (ATM). An example of such a chemical has a elemental mass of 462 is labeled PP6 and is manufactured by F2 Chemicals Limited (Lee Lane, Lea Town, Preston. PR4 ORZ, United Kingdom). The preferred mode of heat transfer using PP6 is single phase heat transfer.

A further embodiment of the present invention wherein the said cooling fluid includes but is not limited to composition of isopropyl alcohol and water.

A further embodiment of the present invention incorporating a heavier cooling fluid that boils at a temperature and pressure well above those found in proximity to an LED, e.g. PP6, manufactured by F2 Chemicals Ltd. Said heavier cooling fluid is in direct contact with said LEDs wherein conduction and convection are the primary modes of heat transfer of heat away from the LED. A further embodiment of the present invention incorporates combinations of fluid transport mechanisms including but not limited to a pump, and to a reciprocating stirrer. The convection is combinations of passive and active flow across the UV. The use of said heavier cooling fluid is preferred because it has a higher boiling point at any given operating pressure than does said cooling fluid. In this embodiment the requirement is for non-boiling conditions for heat transfer, which simplifies the present invention with regard to components including but not limited to the vapor condensing equipment, and to the refrigeration equipment.

A further embodiment of the present invention incorporating an entirely liquid cooling fluid wherein said cooling fluid never vaporizes given the operating pressures and temperatures, the design of the flow means maximizes heat transfer with the minimum amount of

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 30

force and fluid flow. A further property of said cooling liquid produces the useful purpose of flow across the LED in a maximally efficient manner with regards to heat transfer.

A further embodiment of the present invention incorporates a pneumatic force imparting means to said cooling fluid to create forced convection to increase heat transfer fluid force vectors beyond the force vectors provided by the natural convection.

A further embodiment of the present invention incorporates an ultrasonic frequency means to effect the reduction of additional barriers of heat flow near the surface of said LEDs.

A further embodiment of the present invention wherein said fluid motion will be reciprocal such that said cooling fluid near said LEDs is moving across the LED from different angles at different times repeats the pattern, including transverse and random patterns, wherein the usefulness of the pattern allows cooling of varying mass before the cycle is repeated.

In a further embodiment of the present invention said cooling fluid is directed near and between the LED chips allowing for isolating a warm and a cool flow of fluid. Said cooling fluid flows further to an area without active LEDs so that said cooling fluid will cool off. Conduits are incorporated to direct the cooling fluid. The conduits can be of various types including but not limited to micro-channels, to Venturi tube, expansion valves, and to holes of various diameter and porous substrates to within the proper distance from said LEDs to increase flow near and at the surface of the LED including but not limited to Venturi tubes, and to refrigerant expansion tubes.

A further embodiment of the present invention incorporates a second working fluid used as a post LED contact fluid heat exchanger. The use of said post LED contact fluid heat exchanger further captures heat in a phase change thermodynamic cycle including but not limited to a thermodynamic cycle of the Carnot type, to a thermodynamic cycle of the Ericsson type, to a thermodynamic cycle of the Brayton type, to a thermodynamic cycle of the Stirling type, to a thermodynamic cycles of a micro-Stirling engine, and to a thermodynamic cycles of a Stirling engine, wherein thermal heat power to electric power conversion where

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heat flux is converted to electricity through a mechanical vapor phase boiling system incorporating a magnetic generator. Also possible by thermoelectric means with or without said secondary fluid. A further embodiment of the present invention incorporating said second working fluid which is used to create temperature differentials to working energy conversion.

A further embodiment of the present invention wherein said cooling fluid changes phase in a hermetically sealed chamber from a liquid phase to a vapor phase then from a vapor phase to a liquid phase. Said vapor flows under differential pressure to a condensation heat sink and said vapor is absorbed back into said cooling fluid. Mass transfer to a heat sink transfers heat. Said heat sink will be active cooled or passive. Various thermodynamic state changes are effected upon said cooling fluid in a complete thermodynamic cycle within the hermetically sealed chamber.

A further embodiment of the present invention incorporating a hermetically sealed system of a plurality of thermodynamic chambers wherein said cooling fluid changes phase in a first thermodynamic chamber from a liquid phase to a vapor phase then is mass transferred via passive or active means to a second thermodynamic chamber where the fluid changes state from a vapor phase to a liquid phase. Said vapor flows under differential pressure to said second thermodynamic chamber incorporating a condensation heat sink where said vapor is absorbed back into said cooling fluid. Said heat sink will incorporate heat transfer means including but not limited to conduction and forced convection, and to conduction and natural convection. Various thermodynamic state changes are effected upon said cooling fluid in a complete thermodynamic cycle within the hermetically sealed system of a plurality of thermodynamic chambers. The usefulness of the combination of LED with such a heat power to work power conversion means is useful in energy conservation in a commercial market larger than phototherapy which includes general purpose lighting market and the electric generation market.

A further embodiment of the present invention incorporating a heat power to work power conversion process, including but not limited to a Carnot cycle, Stirling cycle, Brayton cycle, Ericsson cycle, wherein the resultant work power is in the form of electric current at a

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active junction electric voltage potential and used to power the LEDs. The usefulness of this process is to effectively increase the efficiency of the present invention.

A further embodiment of the present invention incorporating a heat power to work power conversion process, including but not limited to a Carnot cycle, Stirling cycle, Brayton cycle, Ericsson cycle, wherein the resultant work power is used to induce fluid flow and to operate fans and or pumps.

A further embodiment of the present invention working energy can be used to light the LED and also to operate the pumps.

A further embodiment of the present invention incorporates a porous substrate that provides resistance to the mass transfer of said cooling fluid from a vaporization chamber to a vapor condensation chamber. Said cooling fluid vaporizes in the lower pressure of said vaporizing chamber. Said cooling fluid flows by differential pressure to a vapor condensation chamber for collection. The collected condensation is pumped to said vaporizing chamber to complete the cycle and be available for reuse. Said substrate has a porous structure that variably changes pressure between the liquid state at high pressure in the vapor condensation chamber and the vapor phase on the low pressure side in the vaporization chamber. Said differential pressure is created by a vacuum pump.

A further embodiment of the present invention incorporates a porous substrate that provides resistance to the mass transfer of said cooling fluid from a vaporization chamber to a vapor condensation chamber. Said cooling fluid vaporizes in the lower pressure of said vaporizing chamber. Said cooling fluid flows by differential pressure to a vapor condensation chamber for collection. The collected condensation is pumped to said vaporizing chamber to complete the cycle and be available for reuse. Said substrate has a porous structure that variably changes pressure between the liquid state at high pressure in the vapor condensation chamber and the vapor phase on the low pressure side in the vaporization chamber. Said differential pressure is created by a vacuum pump. Further, said porous substrate has the property of passing vapors but not liquid due in part to liquid surface tensions among other wetting phenomena.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 33

A further embodiment of the present invention incorporates said cooling fluid with the additional property of high dielectric strength, capable of non-ionization at greater than 300 volts per square inch. The usefulness of high dielectric strength is for use with a direct line voltage power supplies that does not require a voltage conditioning element. A power supply without a voltage conditioning element is more efficient since there is no power loss associated with the voltage conditioning element. A power supply without a voltage conditioning element is less expensive to manufacture. Use of a further embodiment of the present invention incorporates a power supply including but not limited to a switching power supply, and to a direct to power connection.

A further embodiment of the present invention incorporating a flexible bladder wherein the position and size of the bladder limits the pressures within the evaporating chamber containing said cooling fluid such that nucleate boiling will occur over a wide range of total enthalpy contents which will promote vaporization at the LED surface that is the preferred area within a narrow temperature range. Nucleate boiling is the preferred mode of operation when wire bonding is performed in a suitable manner which is mechanically and electrically stable under the forces present. Said bladder provides a pressure release and liquid storage capacitance without loss of cooling fluid or the breaking of a hermetic seal, useful for increasing the operating range of the present invention.

A further embodiment of the present invention incorporates a low cost and commercially available UV transparent container for the cavities and chamber lens of the present invention, wherein the useful purpose includes but is not limited to the low cost and commercial availability allows the present invention to reach market sooner at a lower price.

A further embodiment of the present invention incorporates a moving single phase gels wherein said single phase gels are constantly spatially moved in relation to to said LED in manner which forces convection at the LEDs surfaces, including but not limited to the motive methods of shaking, sliding, and bubbling

A further embodiment of the present invention incorporates a phase

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change gels means wherein said phase change gel means is spatially moved in relation to said LED in a manner which increases conduction heat transfer with forced convection at said LEDs surfaces, wherein said phase change gel means undergo a phase change due to heat transfer during the flow in proximity to said LEDs. Said gel thermodynamic phase change includes but is not limited to first solid phase to second solid phase change, reversible chemical reaction, liquid to vapor phase change, or other thermodynamic property change.

A further embodiment of the present invention incorporates a coating on said LEDs to protect said LEDs from the chemical reaction potential of said cooling fluid and the force of said cooling fluid flow. Said coating is preferably a highly transparent coating, and in the application of indoor tanning a highly UV transparent coating, the composition of said coating is comprised of materials including but not limited to silicone compounds, to silicone sealant, and to epoxies. Said coating is applied by combinations manufacturing methods including but not limited to the manufacturing method of injection molding, chemical curing, photo curing, the manufacturing method of thin film sputtering, and the manufacturing method of spray coating. A further method which creates micro pits on the surface of the coating by means including but not limited to mechanical etching, and to chemical. Said chemical etching may incorporate sacrificial beads of small dimension to create pitting sites during he chemical etching process.

A further embodiment of the present invention incorporating the method of eliminating portions of the encapsulant from standard light emitting diodes to increase the heat transfer by reducing the thermal resistance from the LED active junction, encapsulated within the encapsulant, to said cooling fluid flow outside the encapsulant.

A further embodiment of the present invention incorporating open framed light emitting diodes. Said open framed light emitting diodes are not encapsulated. The use of open framed UV light emitting diodes reduces the manufacturing tooling costs associated with custom chip on board technology while still allowing for the direct contact immersion cooling of said LED die. Said open frame LED of types including but not limited to 3 millimeter type T-1, 5 millimeter type T-1 3/4, surface mount type, and 8 millimeter type.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 35

A further embodiment of the present invention incorporating the simplified method of manufacturing the present invention by diverting open framed light emitting diodes out of an industry standard LED manufacturing process after the wire bonding manufacturing process and before the encapsulation manufacturing process is applied. Said simplified method of manufacturing claims the benefit of providing a means of removing said open framed light emitting diodes in a manner that protects the open framed light emitting diode and maintains the forces within the normal forces applied to said open framed light emitting diodes. Said simplified method of manufacturing further incorporating a means for assembling said open frame LEDs in a manner that maintains forces below the maximums to which said open framed light emitting diodes will be subjected to without damage. The advantage of said simplified method is to reduce the cost of manufacture since the tools to manufacture encapsulated LEDs exist and the method of manufacturing open framed light emitting diodes requires only the additional means and method of diverting said open framed light emitting diodes, and LED protecting shield means.

A further embodiment of the present invention that incorporates die bonded open frame LEDs. Wherein a second simplified method of manufacturing the present invention by diverting open framed light emitting diodes out of an industry standard LED manufacturing process after the die bonding manufacturing process and before the wire bonding manufacturing process is applied. Said second simplified method of manufacturing claims the benefit of providing a means of removing said die bonded open framed light emitting diodes in a manner that protects the die bonded open framed light emitting diode and maintains the forces within the normal forces applied to said die bonded open framed light emitting diodes. Said second simplified method of manufacturing further incorporating a means for assembling said die bonded open frame LEDs in a manner that maintains forces below the maximums to which said die bonded open framed light emitting diodes will be subjected to without damage. The advantage of said second simplified method is to reduce the cost of manufacture since the tools to manufacture encapsulated LEDs are known and are presently in operation and said second method of manufacturing die bonded open framed light emitting diodes requires only the means and method of diverting said die bonded open framed light emitting diodes, and LED protecting shield means.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 36

A further embodiment of the present invention incorporating a method of manufacturing the present invention from a LED wafer. Wherein said LED wafer contains multiple LEDs sites. Wherein said LED wafer is bonded to an elastic holding tape. Subsequently, said LED wafer and elastic holding tape is selectively sliced through the LED wafer between the LED sites without slicing entirely through said elastic holding tape to render closely spaced separated LED die and said elastic holding tape. Subsequently, said elastic holding tape is expanded in two dimensions in a controlled manner into a set of moderately separated LED die, wherein the separation between separate LED die is on the order of 0.5 millimeters. Wherein said set of moderately separated LED die are bonded to a second wafer substrate that incorporates electrical conducting means and incorporates other mechanical functions including but not limited to optical prisms, and optical waveguides. Said wafer substrate provides a means for selectively electrically isolating said LED die. The usefulness of this manufacturing method is parallel manufacturing techniques which eliminates many intermediate steps of packaging and testing individual LED die sawn from the LED wafer in standard manufacturing processes.

A combination of reflective surfaces or optical pipes to direct light from a horizontal light due to vapor phase changes to any direction of light.

A further embodiment of the present invention wherein said wall of enclosure has a light modifying means in order to redirect the light in a manner that distributes the light according in a manner consistent with a indoor tanning mode or a phototherapy mode. Light modifying means is a lens. Light modifying means includes but is not limited to reflective surfaces, optical lens, and light pipes.

A further embodiment of the invention incorporating a magnetic fluid means, including but not limited to a magnetic fluid wherein, said magnetic fluid has elements including but not limited to iron, nickel. Additional magnetic fluids are that comprise a magnetic material selected from a group consisting of Cr, Mn, Fe, Co, Ni, V, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Ac, Th, Pa, U, Ne, Pu, Am, Cm, Bk, Cs, Es, Fm, Md, No, Lr, Tb--Fe, Gd--Fe, Nd--Fe, Gd--Co, Er--Ni, U--Co, Fe.sub.4 N, Fe.sub.5 N, and Fe.sub.3 O.sub.4. Said magnetic fluid is preferably capable of high dielectric strength

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 37

in LED systems without LED coating. If high dielectric strength or chemical incompatibility with LED is not sufficient for the lifetime of the product then a coating on the LEDs will be required. The coating creates additional thermal resistance which increases the active junction temperature, and therefore the preferred coating will have the minimal heat transfer coefficient possible with the life expectancy greater than the failure of the LED.

A further embodiment of the invention incorporating a paramagnetic fluid means, including but not limited to a paramagnetic fluid wherein, a paramagnetic material comprise a paramagnetic material selected from the group consisting of silica, alumina, yttria, zirconia, hafnia, titania, niobia, Ag, Al, Cu, Si, Au, Pt, Pd, Rh, Ru, Mo, Nb, Ta, W, Ti, V, Zr, Hf, Y, Re, Ir, Ga, In, Sn, Pb, Zn, Cd, Hg, Ag--Al, Cu--Al, Pd--Ag, Al.sub.2 O.sub.3, SiO.sub.2, BN, NbN, TaN, TiN, Fe.sub.2 O.sub.3, CoO, Ni.sub.3 Al, and FeAl. Said paramagnetic fluid is preferably capable of high dielectric strength in LED systems without LED coating. If high dielectric strength or chemical incompatibility with LED is not sufficient for the lifetime of the product then a coating on the LEDs will be required. The coating creates additional thermal resistance which increases the active junction temperature, and therefore the preferred coating will have the minimal heat transfer coefficient possible with the life expectancy greater than the failure of the LED.

Said magnetic fluid means passes through a micro coil fabricated utilizing methods including but not limited to fabrication of micro wires using epitaxial growth within the substrate as layers epitaxial mode, fabricated on the surface as bonded components, which creates the electric field potential in the coils as the magnetic fluid comes to magnetic saturation. Magnetic saturation in said magnetic fluid decreases after passing through said non-energized micro coil and entering open ventricle of micro stirling engine wherein there is cooling due to the magnetic interactions of the magnetic fluid that begins to randomize from the heat contained in a cold source within the magnetic forces between the magnetic fluid. Each time the magnetic fluid passes between thermodynamic chambers the magnetic energy will either be absorbed or allowed to pass through depending on the controlled state of said current control means.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 38

A further embodiment of the present invention regenerates electricity by operating the current control means in a second mode where the heat of the electrically powered first LED produces mechanical pressure in a first magnetic fluid chamber forcing said magnetic fluid through a micro coil aperture into a second magnetic fluid chamber which creates an electric current potential useful for generating electric energy. As the ferromagnetic fluid passes through the micro coil the ferromagnetic fluid is cooled. At the end of the cycle the first LED is no longer powered and a second LED in contact with second magnetic fluid chamber transitions from no power to power which heat the magnetic fluid in the second chamber and forces the magnetic fluid back into said first magnetic fluid chamber in combination with a current switch receiving current from the micro coil which rectifies the current through the coil in the opposite polarity relative to the first cycle which is useful for power generation. In addition to regenerating electric current from heat the fluid flow cools the LED surface providing longer life at overdriving conditions.

A further embodiment of the present invention comprised of integral components including but not limited to LEDs, and to high temperature magnetic refrigerator means, for the useful purpose of cooling said LEDs without a compressor which is a significant point of failure.

A further embodiment of the present invention incorporating combinations of LEDs and paramagnetic means including but not limited to paramagnetic fluid useful for the purpose of operating a magnetic refrigeration means.

A further embodiment of the present invention incorporating combinations of LEDs and thermal switches including but not limited to Peltier devices, and to a thermoelectric switch for the useful purpose of controlling a thermodynamic cycle including but not limited to a Carnot cycle, a Stirling cycle, an Ericsson cycle, and a Brayton cycle.

The use of perfluorocarbon fluid with an integral magnetic element such as Iron or Nickel, Ferrofluid, ferroperfluorocarbon fluid, including the Flutec Ltd, fluid. Ferrofluid fluid. Magnetic cooling by energy extraction of ferromagnetic element aligning with coils and

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molecular movement is lowered thus lowering the temperature of the magnetic fluid.

A further embodiment of the invention wherein said current control means are transistors including but not limited to bipolar or field-effect type transistors depending on manufacturing process, wherein the preferred type is field effect transistor (FET) with FET gate control means for low on resistance and high off resistance.

The bipolar devices useful for controlling current include but is not limited to semiconductor junction diodes in a bridge configuration wherein the logic for the current drive is built into the self rectifying device. This configuration of semiconductor junction diodes will requirement capacitor charging and bleeding circuits. The use of diodes causes an energy loss due to wasteful increase in the forward voltage drop in the range of 0.6 to 0.4 volts depending on materials an semiconductor doping levels and environmental temperatures. The use of bipolar transistors allows a lower forward operating junction of 0.2 to 0.1 volts, in which case a base current is needed to drive the active junction into conduction.

The use of FETs requires the addition of FET gate control means for the useful purpose of biasing the FET gates at the proper part of the cycle to create useful power. The bipolar devices such as the bipolar diodes do not require an elaborate control means because the diodes inherently only conduct significantly in one direction.

The field effect based current control means requires a controller, typically a computer or semiconductor logic based control system requiring incorporating logic means including but not limited to microcontroller, to mechanical logic, to micromechanical (MEM) logic, and to electronic logic. The temperature of the LED active junction temperature provides a measurement feedback feedback to the control system. Alternatively, properties of the cooling fluid are measured which includes but is not limited to cooling fluid temperature, a second cooling fluid temperature, a cooling fluid flow, and a cooling fluid pressure, the temperature of the cooling fluid is measured and additional information is used to predict the LED active junction temperature. More than one measurement is useful, and backup measurements are useful also.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 40

A further embodiment of the invention is a heat engine control means for controlling the operating conditions of the micro-stirling engine. Said heat engine control means is a system with inputs including but not limited to temperature, pressure and fluid flow, and a calculating machine, and an output means capable of controlling electric power to the LEDs in order to maintain a light flux within the operating bounds of the device. If excess illumination production capacity in the LED system exists then electric power to said LEDs will be turned off in a pattern that would allow a controlled light flux useful for the purposes of a phototherapy.

A further embodiment of the present invention incorporates a micro valve. When enough vapor pressure is produced a micro valve is opened to release the pressure and exchange the fluids with the reciprocal fluid attached via a second micro valve that is in addition in an alternating state from said first micro valve.

A further embodiment of the present invention incorporates a micro valve in combination with magnetic fluid and coils for the useful purpose of providing a refrigeration means. When enough vapor pressure is produced a micro valve is opened to release the pressure and exchange the fluids with the reciprocal fluid attached via a second micro valve that is in addition in an alternating state from said first micro valve.

A further embodiment of the present invention incorporates a micro valve in combination with magnetic fluid and coils for the useful purpose of providing a heat power to work power conversion means. When enough vapor pressure is produced a micro valve is opened to release the pressure and exchange the fluids with the reciprocal fluid attached via a second micro valve that is in addition in an alternating state from said first micro valve.

A further embodiment of the present invention which incorporates a plurality of micro valves.

A further embodiment incorporates temperature sensors.

A further embodiment incorporates pressure sensors and vibration sensors.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 41

A further embodiment incorporates flow sensors.

A further embodiment incorporates combinations of temperature sensors, pressure sensors, and flow sensors.

A further embodiment incorporates combinations of temperature sensors, pressure sensors, and flow sensors and a controller subject the inputs of the sensors creating an action. In order implement said engine control means said sensors and communications means also required to all the controllers and systems on the present invention.

A further embodiment incorporates transducer means and communications means to communicate combinations of temperature sensors, pressure sensors, and flow sensors and a controller subject the inputs of the sensors creating an action. In order implement said engine control means said sensors and communications means also required to all the controllers and systems on the present invention.

The mechanical nature of the micro machine known in the prior art as micromechanics (MEMs), allows control programs to be built into the mechanical structure.

A plurality of micro-stirling engines.

A plurality of micro valves and a macro stirling engine. Whereby a plurality of micro valves charges alternatively one ventricle or the other.

A further embodiment of the present invention wherein said micro stirling engine is a micro mechanical stirling engine.

A further embodiment of the present invention incorporating a macro sized Stirling engine is used to convert heat power into electric power.

A further embodiment of the present invention incorporating a refrigerator means, wherein said refrigerator means includes but is not limited to a modified air conditioner, to magnetic refrigeration means, to active regenerative magnetic refrigerator means, and to perfluorocarbon refrigeration means.

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 42

A further embodiment of the present invention incorporating an evacuating means to create a decreased vapor pressure in said LED enclosure with an integrated vaporizing chamber which lowers the boiling point of said cooling fluid in contact with the LEDs.

A further embodiment of the present invention incorporating a vapor evacuating means and said vapor condensing chamber with integral heat exchanger. Wherein said vapor evacuating means creates a decrease in the vapor pressure in said LED array enclosed said vaporizing chamber which lowers the boiling point of said cooling fluid in contact with said LEDs. Said evacuating means transfers said vapor to a vapor condensation chamber with integral heat sink. Within said vapor evacuating means the vapor temperature increases due to the adiabatic compression which allows for the vapor compression chamber with integral heat sink to operate with increased efficiency. The usefulness of increased efficiency is the smaller size of the vapor compression chamber integral heat sink. Said evacuating means is preferred to be powered via an electric motor connected to an external electric power source, but an alternative source of power would be pneumatic or mechanical work, and in particular an alternative source of power is generated by the optional stirling engine when available.

A further embodiment of the invention wherein said modified refrigeration means is a commercially available air conditioner modified to cool said LEDs. Such a standard unit has modified piping which diverts and transfers coolant to said LED enclosure to directly cool said LEDs, with the addition of piping and fixtures to direct said cooling fluid from the normal route to the heat exchanger for cooling the air. In a commercially available air conditioner the cooled compressed refrigerant is transferred to said LED array in place of the heat exchanger for cooling the air, wherein the useful purpose is to use low cost commercially available components and to modify the components accordingly for the cooling of LEDs in a cost effective manner.

Semiconductor compounds from various elemental groups such as II-V, IV-IV, IV-VI, III-VI, II-VI are useful for creating photonic emissions. Especially useful for UV emissions is the semiconductor compound ZnO. What is described here is a novel application for the use of UV photons generated from semiconductor luminous nanocrystals

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for the useful purpose of provisioning light for phototherapies including but not limited to indoor tanning, and to lupus therapy.

The application that is being described here is that of wavelength specific indoor tanning and phototherapy. The advantages of the use of semiconductor luminous nanocrystals in this application is the ability to control the wavelength of the photonic emissions. This is desirable in the specific application of certain procedures which require arbitrary wavelengths applied in arbitrary sequences. A further embodiment of the present invention includes the method of measuring, recording, storing, and retrieving historical data for the useful purpose of increasing reliability and failure prediction.

It is expected that as the science of phototherapy advances and in the experimental stages of the science a mechanism will be required to selectively control the wavelength of the applied light in a sequential manner. One or more wavelength from time t.sub.1 to time t.sub.2, none or more wavelength from time t.sub.2 to time t.sub.3, and one or more wavelength from time t.sub.3 to time t.sub.4, with a continuation as required. To implement this sequence of phototherapy, the use of tuned semiconductor luminous nanocrystals is desirable.

A further embodiment of the present invention incorporates nanocrystals to tune the wavelength for a phototherapy. Nanocrystals are capable of accepting a wide range of light generally of shorter wavelengths and emitting light at a longer wavelength in narrow wavelength ranges dependent on the size of the nanocrystals.

A UV light source with a lower wavelength is useful for provisioning light used to optically pump the tuned luminous nanocrystals. Other modes of optically pumping the luminous nanocrystals are useful such a harmonic coherence in which light sources of two or more wavelengths are optically combined to produce at least one additional wavelength than the sources. The specification of a UV light sources providing the initial light for the optical pump have relaxed wavelength specifications because the useful phototherapy photons are produced from the stable semiconductor luminous nanocrystals which are capable of accepting a larger range of wavelengths for optical pumping than the emitted light wavelength range. By replacing the phosphor chemistry with semiconductor luminous

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nanocrystals for use in phototherapy applications, a UV light source, including but not limited to mercury vapor bulbs. Fluorescent mercury vapor bulbs have an extended useful lifetime when using the semiconductor luminous nanocrystals as a spectrum modifier frequency converter. In effect, replacing the mercury vapor bulb phosphors with nanocrystals will increase the life of the fluorescent bulbs.

A further embodiment of the present invention incorporates specialized current to voltage waveforms means to power said LED array in order to maximize the useful life of said LED array. The power waveform is complex and in the optimum condition allows for the most effective mode to maintain the life of the LED. Under circumstances the DC is preferred as is to train the LED to emit light, taking into account prior history and power densities.

A further embodiment of the present invention incorporates control means to operate the LED as a set. Another mode of operation of the invention incorporates a granular control means that is capable of individual control of each individual LED in said LED array, also known as addressable control and power means.

A further embodiment of the present invention incorporates control means to operate the LED as a set. Another mode of operation of the invention incorporates a granular control means that is capable of individual control of each individual LED in said LED array. Wherein each subset is defined as a collection in which the number a frequency of operation of each LED in a subset is dynamic and changes due to external influences such as stresses induced by temperature or flow conditions, and in manufacturing burn in conditions.

Measurement of light flux and electric current and voltage measurements will determine real time properties of each LED for use in the dynamic power control means.

A further embodiment of the present invention incorporating real time LED effectiveness testing means for the useful purpose of increasing efficiency by powering the most effective LEDs for the most time. Said real time LED effectiveness testing means sets individual LED power control by feedback of information that detects whether the skin is in exposure to the UV rays, the method of which first turns

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 45

off all LEDs, then power individual LEDs one at time and read the value of a light measuring device, which determines which LED is not hitting the skin. An improved novel algorithm that predicts the most likely LEDs to change power states by using the immediate historical data and tests the most likely LEDs for transmission more often than LEDs that are predicted to remain in the same powered state, this allows less scans to be required, because the edge is always being detected and thus the power savings is achieved. Predictive analysis means with quality controls. The power states of the LEDs are either on, off, ready to go on, ready to go off.

A further embodiment of the present invention incorporating backup systems which are useful for increasing the reliability of all the system components including power means, control means and communication means. Under special operational conditions the procedure change if a system component contains a backup system component.

A further embodiment of the present invention incorporating cryogenic refrigeration objects and methods for combinations of useful purposes including but not limited to the useful purpose of increasing the reliability of said LEDs, the useful purpose of increasing the light flux of said LEDs, and the useful purpose of increasing the efficiency of the electric power to photonic power conversion.

A further embodiment of the present invention incorporating magnetic refrigeration objects and methods for combinations of useful purposes including but not limited to the useful purpose of increasing the reliability of said LEDs, the useful purpose of increasing the light flux of said LEDs, and the useful purpose of increasing the efficiency of the electric power to photonic power conversion.

A further embodiment of the present invention wherein a light provisioning means in comprised of combinations of components including but not limited to said LED array, and said mercury vapor bulbs, wherein said LED array is useful for the purpose of phototherapy including but not limited to indoor tanning, and lupus therapy.

A further embodiment of the present invention incorporating at

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 46

least one light wave guide means, for the useful purpose of provisioning light from remote sources relative to the phototherapy chamber, on the order of 100 feet or less. The useful purposes of provisioning light remotely includes but is not limited to the purpose of time sharing the light provisioning source, the purpose of more effective cooling at a remote location, the purpose of matching the number of phototherapy chambers with the number of LED arrays to reduce the need for cooling. By sharing a set of common light sources the cost of expensive light provisioning component is decreased per phototherapy chamber. An algorithm to determine the optimum balance between the number of LED light sources and cooling requirements and sharing means allows the design of a shared light source phototherapy system to meet individual enterprise goals.

A further embodiment of the present invention incorporating modular components designed to facilitate upgrades, changes due to changing requirements, maintenance, recycling, and reuse.

A further embodiment of the present invention incorporating fraud prevention means including but not limited to radio frequency identification devices, to bar codes, to fingerprint recognition, to facial recognition, to retinal recognition. Fraud prevention means is useful in tracking the state of the present invention in the field as it is used and to verify that the use is according to license agreements.

A further embodiment of the present invention incorporating licensing verification means including but not limited to remote access to unique token servers. One mode of marketing the present invention includes the use of a per diem license. One method of administering a per diem license includes but is not limited to remote access through the Internet or other communications means to access a payment system and verification system. Per diem controls local to the enterprise would operate only under proper conditions including but not limited to verification of valid token with remote token verification system.

A further embodiment of the present invention incorporating phototherapy chamber lockout control means responsive to said license verification means for the useful purpose including but not limited to

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 47

implementing a license and preventing fraud.

A further embodiment of the present invention incorporating communication means including but not limited to cell phone circuits, to 802.11 circuits, to satellite circuits, Telco POTs circuits, Cable modem circuits, wherein said communications means is useful for the purpose of implementing business processes capable of managing the present invention remotely.

A further embodiment of the present invention incorporating said light provisioning means, a plurality of said light wave guide means, and a light directing means, for the useful purpose of provisioning light from remote sources relative to the phototherapy chamber, on the order of 100 feet or less. The useful purposes of provisioning light remotely includes but is not limited to the purpose of time sharing the light provisioning source, the purpose of more effective cooling at a remote location, and for the purpose of reducing the number of components in a multiple phototherapy chamber enterprise by time sharing the LED array. Wherein said light directing means switches the direction of light from one wave-guide to another depending on a control system which manages the sharing of the light provisioning means.

A further embodiment of the present invention incorporating a plurality of light provisioning means, a plurality of said light wave guide means, and a plurality light directing means, for the useful purpose of provisioning light from remote sources relative to the phototherapy chamber, on the order of 100 feet or less. The useful purposes of provisioning light remotely includes but is not limited to the purpose of time sharing the light provisioning source, the purpose of more effective cooling at a remote location, and for the purpose of reducing the number of components in a multiple phototherapy chamber enterprise by time sharing the LED array. Wherein said light directing means switches the direction of light from one wave-guide to another depending on a control system which manages the sharing of the light provisioning means.

A further embodiment of the present invention incorporating said light wave guide means wherein said light wave-guide means are comprised light transmitting means including but not limited to light

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 48

collecting means, reflective mirrors, and reflective tubes.

A further embodiment of the present invention incorporating said light wave guide means wherein said reflective tubes are hollow.

A further embodiment of the present invention incorporating said light wave guide means wherein said reflective tubes are fiber optic tubes, comprised of materials including but not limited to glass, plastic, UV transparent fluid.

A further embodiment of the present invention incorporating combinations of cooling means and heating means responsive to an LED active junction temperature control system wherein the heating means is useful for controlling the elevated temperature from the ambient without powering the LED, which is useful in conditions where a specific wavelength shift is required and the wavelength of emissions of the LED at any other than said specific wavelength is prohibited. In this case the LED needs to be preheated with the heating means to said elevated temperature before being powered. Once the LED is powered the heating means output is reduced in a controllable manner because the LED is creating heat internally which maintains the elevated temperature of the LED active junction temperature. Once the LED is powered the heating means and cooling means are selectively controlled to maintain the elevated temperature of said LED active junction.

A further embodiment of the present invention incorporating an opaque shield capable of selectively blocking light emitted from said LED array. Said opaque shield is responsive to an opaque shield control system with inputs including but not limited to ambient temperature measurement, set points, stored data sequence of set point variations with time, emitted light wavelength measurement means, emitted light power measurement means and output means including but not limited to opaque shield actuator means. Said opaque shield actuator means is capable of selectively blocking said emissions or passing said LED emissions.

Said opaque shield composed of one or more devices including but not limited to a plurality of mechanical shutters, liquid crystal shutter, and mechanical iris with lens, and combinations thereof. A

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mode of operation of said opaque shield capable of blocking light in a continuously variable manner between complete opaque to complete translucent. A second mode of operation of said opaque shield capable of blocking light in a discrete manner between two or more states of opaqueness including but not limited to almost completely opaque, almost completely translucent, partially opaque, and partially translucent.

LED WAVELENGTH SELECTION - SUMMARY

365 nm is a good wavelength for indoor tanning with moderate health hazards.

More wavelengths are preferred because of uncertainties in UV hazards at any single wavelength.

Skin tans easier at the lower wavelengths between 400 nm and 340 nm, compensating for the lower power output of the LEDs. Thus, the LEDs relative effective indoor tanning power is fairly constant over wavelength.

The least hazardous wavelengths for indoor tanning is 352 nm, subject to available data conditions.

The range 340 nm - 365 nm and 390 nm - 400 nm are also relatively low in hazard.

The actual LED wavelength selection criteria is complicated and based on action spectra including but not limited to UV LED Power Output versus Wavelength action spectra, to Hazards versus Wavelength action spectra, to Pigmentation versus Wavelength action spectra, to Cost versus Wavelength action spectra. Further, the known action spectra are normalized and variations among different individual tanners exist which are factors to be included in an analysis and indoor tanning chamber control system.

LED WAVELENGTH SELECTION - TODO

Obtain the Power Output versus Wavelength estimates from Cree, Inc. to get a more accurate preferred wavelength analysis.

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 50

Obtain estimates for cost per LED or relative cost per LED as a function of wavelength.

Determine requirements for obtaining a contract to purchase non-standard (e.g. 365 nm) parts from Cree, Inc.

Research additional Action Spectra and determine their applicability for LED based indoor tanning application.

LED WAVELENGTH SELECTION - GENERAL CONSIDERATIONS

It is known that some wavelengths are more capable of indoor tanning than others. Indoor tanning with a single or multiple narrow bands of UV has not been studied extensively, if at all. Currently, a large band of wavelengths are employed for indoor tanning due to the unknown health risks at any given wavelength. The broad spectrum of UV wavelengths reduces the effect of any single hazardous wavelength. The indoor tanning industry has hedged its bets. Eventually, undesirable indoor tanning wavelengths will be identified. Eventually the FDA will require filters for these wavelengths. The UV LED based approach will allow for selection of preferred wavelengths. The FDA regulations will be an advantage to the UV LED indoor tanning methods, since filters may be avoided.

Much of the wavelength selection decision tree is based on available action spectra. An action spectrum correlates data regarding a specific function over wavelength. One of the main considerations is the Carcinogenic Action Spectrum (see Figure 2). The other significant set of data is the Pigmentation Action Spectra (see Figure 1).

LED WAVELENGTH SELECTION - CARCINOGENESIS ACTION SPECTRA: LONG UVA (340 nm - 400 nm)

This experiment was performed with narrow wavelengths bands, which would indicate that this data is applicable to the LED selections, for a single wavelength. What remains unanswered is the carcinogenesis activity, when more than one narrow band is applied. There are many unanswered questions regarding the possible beneficial interaction of multiple wavelengths. Experiments that promote wavelength selectivity will require filters or LEDs to implement devices based upon the new

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 51

health discoveries.

In general, there is much research in the field of UV health risks due to the atmospheric ozone layer depletion. The ozone affects a broad spectrum of UV and such research may not be applicable to an LED device with one or more narrow bands of UV.

LED WAVELENGTH SELECTION - CARCINOGENESIS ACTION SPECTRA: UVB (290 nm - 320 nm)

Relative to UVB the long UVA band has a fairly flat action spectrum for carcinogenesis. Until more findings are discovered and disclosed in this field, the carcinogenesis action spectra suggests only moderate gains in selecting 340 nm to 365 nm and 390 nm to 400 nm and excluding 365 nm to 395 nm. Relative to UVB the entire UVA band (340 nm - 400 nm) is orders of magnitudes less of a hazard. Thus any UVA wavelength is a potentially valid wavelength in a UV LED indoor tanning device.

LED WAVELENGTH SELECTION - PIGMENTATION ACTION SPECTRA

Given the findings shown in the "Pigmentation Action Spectrum", for relative effectiveness of indoor tanning, 340 nm is the most effective wavelength, 365 nm is 70% effective at indoor tanning compared to 340 nm. It may be that 355 nm is the lowest wavelength that would be useful for indoor tanning given the trade-off of luminous power output diminishing with lower wavelengths. The data for LED power output at various wavelengths is required to analyze LEDs for indoor tanning applications, and to determine the lowest realizable LED wavelength.

LED WAVELENGTH SELECTION - LED POWER OUTPUT VERSUS WAVELENGTH

Estimates of the luminous power output at the various wavelengths generated table 1. The actual power output at the wavelengths allows a calculation of the number of LEDs at each wavelength to make a near-full spectrum LED indoor tanning solution. The near-full spectrum indoor tanning solution has the least near term market acceptance risk because it resembles the current product.

LED WAVELENGTH SELECTION - OTHER FACTORS

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Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 52

Other factors affecting choice of wavelength for a given indoor tanning session include but are not limited to; cost variations between differing wavelength UV LEDs, per session UV dose, cumulative broad UV dose, cumulative specific UV dose, UV dose required to achieve a tan, UV dose required to maintain a tan, and the time between tan history.

LED WAVELENGTH SELECTION - CONSUMER PREFERENCES AND BEHAVIORS

The LED indoor tanning application is not simply a matter of finding the wavelengths for the most energy efficient tan. It is also known that various UV wavelengths produce differing skin color results, and have different persistence characteristics. This principle can be used to increase the value of LED indoor tanning, because the value of having multiple controllable wavelengths provides the possibility of selecting different tanned skin color results or selecting level of persistence. The added value is in customers who could customize their skin color or customize the interval between the indoor tanning sessions, or both. Long UV tan tends toward yellow and short UV toward red.

LED WAVELENGTH SELECTION - MINIMIZING POWER, MINIMIZING COMPONENT COSTS

Given equal price and availability any wavelength UV LED down to 340 nm would be useful for indoor tanning. However, varying cost for varying wavelengths will provide additional criteria to select useful wavelengths for UV LEDs. This cost information is required to make such determinations.

LED WAVELENGTH SELECTION - CUMULATIVE UV EXPOSURE AT ALL WAVELENGTHS, AND SPECIFIC WAVELENGTHS

Given all the unknowns, it seems prudent to consider the persistence of a tan has a factor in the value of the wavelength. Since the longer wavelengths last longer, significantly longer, less overall radiation is required to maintain a tan. Therefore, the total dose of UV is smaller over a long period of time. Longer UV penetrates deeper and thus produces a more persistent tan. Less total UV is required to maintain a more persistent tan.

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 53

LED WAVELENGTH SELECTION - INDIVIDUAL PHOTOBIOLOGY

Sensitivities will vary from one individual to another, and depending on biological and pharmacological conditions. Differing conditions may produce differing results for constant UV doses. Certain medications have action spectra that should be taken into consideration. Again, LEDs will be an advantage in selecting appropriate wavelengths for specific conditions.

The analysis calculations determine optimum wavelengths different for different criteria. For least indoor tanning power the optimum wavelengths for LED indoor tanning is 370 nm. If health is a consideration the wavelengths are closer to 350 nm. Even so, the more wavelengths available the better because of the possibility to select bands for specific customer needs.

LED WAVELENGTH SELECTION - CONCLUSION

In conclusion, once the power output and relative cost per LED is known, a calculation will show which wavelengths are the best for different criteria. However, given the condition that more wavelengths may be better matched to current indoor tanning methods, I would re-iterate that currently a near-full UV spectrum is currently the best. As time goes on, and as more is learned regarding the effects of specific UV wavelengths on health, it may then be required to avoid wavelengths that would otherwise be known health risks for certain people.

A further embodiment of the present invention incorporating a plurality of luminous nanocrystals useful for purposes including but not limited to the conversion of photons of a first wavelength range into photons of a second wavelength range, and for use in provisioning arbitrary specific wavelength ranges for arbitrary phototherapy methods including but not limited to indoor tanning, sleroderma therapy, scleriasis therapy, and to lupus therapy, photopheresia, and photochemotherapy.

A further embodiment of the present invention incorporating a plurality of luminous nanocrystal of arbitrary types and arbitrary sizes, useful for purposes including but not limited to the conversion

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of photons of a first wavelength range into photons of a plurality of wavelength range, and for use in provisioning arbitrary specific wavelength ranges for arbitrary phototherapy methods including but not limited to indoor tanning, sleroderma therapy, scleriasis therapy, and to lupus therapy, photopheresia, and photochemotherapy.

A further embodiment of the present invention incorporates at least one modified light source wherein said modified light source is comprised of combinations of materials including but not limited to, LEDs, LED enclosure, mercury vapor, fluorescent light bulb enclosure, Cadmium Sulfide (CdS), Lead Sulfide (PbS), Silicon (Si), Zinc Sulfide (ZnS), Aluminum (Al), Carbon (C), Copper (Cu), Gold (Au), Aluminum Nitride (AlN), Boron Carbide (BC), Titanium Oxide (TiO2), Titanium Oxide (TiO), Zinc Oxide (ZnO), Alumina (Al2O3), Ceria (CeO2), Silica (SiO2), Silicon Carbide (SiC), Aluminum (Al), Antimony (Sb), Arsenic (As), Bismuth (Bi), Cadmium (Cd), Carbon (C), Gallium (Ga), Germanium (Ge), Indium (In), Phosphorus (P), Selenium (Se), Silicon (Si), Sulfur (S), Tellurium (Te), Zinc (Zn), Calcium (Ca), Chromium (Cr), Cobalt (Co), Copper (Cu), Gold (Au), Iron (Fe), Magnesium (Mg), Manganese (Mn), Nickel (Ni), Palladium (Pd), Platinum (Pt), Silver (Ag), Tantalum (Ta), Titanium (Ti), Tungsten (W), Vanadium (V), Zirconium (Zr), Aluminum Oxide (AlO), Boron Carbide (B2C), Boron Carbide (BC), Boron Carbide (BC), Cerium Oxide (CeO2), Cerium Oxide (CeO), Silicon Arsenide Germanium Telluride (SiAsGeTe), Silicon Oxide (SiO2), Silicon Oxide (SiO), Titanium Oxide (TiO2), Titanium Oxide (TiO), Vanadium Oxide (V2O3), Vanadium Oxide (VO), Zinc Germanium Phosphide (ZnGeP2), Zinc Germanium Phosphide (ZnGeP), Zirconium Dioxide (ZrO2), Aluminum Antimonide (AlSb), Aluminum Arsenide (AlA), Aluminum Nitride (AlN), Aluminum Phosphor (AlP), Cadmium Selenide (CdSe), Cadmium Telluride (CdTe), Gallium Antimonide (GaSb), Gallium Arsenide (GaAs), Gallium Phosphide (GaP), Gallium Selenide (GaSe), Gallium Telluride (GaTe), Indium Antimonide (InSb), Indium Arsenide (InAs), Indium Phosphide (InP), Lead Selenide (PbSe), Lead Sulfide (PbS), Lead Telluride (PbTe), Silicon Arsenide Telluride (SiAsTe), Silicon Carbide (SiC), Silicon Germanium (SiGe), Zinc Oxide (ZnO2), Zinc Oxide (ZnO), Zinc Selenide (ZnSe), and Zinc Telluride (ZnTe), providing a useful purpose including but not limited to the conversion of photons of a first wavelength range into photons of a second wavelength range, and for use in provisioning arbitrary specific wavelength ranges for arbitrary phototherapy methods including but not limited to indoor tanning,

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sleroderma therapy, scleriasis therapy, and to lupus therapy, photopheresia, and photochemotherapy. Further, elemental molar concentrations of said nanocyrstals are arbitrarily chosen to meet criteria set forth by phototherapy requirements.

A further embodiment of the present invention incorporating said fluorescent bulb phosphor composed of elements and compounds including but not limited to luminous nanocrystals of arbitrary size and composition including luminous nanocrystals of zinc and oxygen elemental composition forming zinc oxide crystals of of approximately 1 nm in size, useful for the purpose of generating ultraviolet light for use in photothérapies including but not limited to indoor tanning, and lupus therapy.

A further embodiment of the present invention incorporating said fluorescent bulb phosphor composed of elements and compounds including but not limited to luminous nanocrystals of arbitrary size and composition including luminous nanocrystals of zinc and oxygen elemental composition forming zinc oxide crystals of of approximately 2 nm in size, useful for the purpose of generating ultraviolet light for use in photothérapies including but not limited to indoor tanning, and lupus therapy.

A further embodiment of the present invention incorporating said phosphor composed of elements and compounds including but not limited to luminous nanocrystals of arbitrary size and composition, wherein said luminous nanocrystals are composed of compounds including Cadmium Sulfide, Cadmium Selenide, Lead Sulfide, and Zinc Sulfide, for use in photothérapies including but not limited to indoor tanning, and Lupus therapy, and in addition for use in general purpose lighting.

The usefulness of using luminous nanocrystals within the phosphor composition is that a UV fluorescent bulb no longer needs blocking filters to provision a narrower range of wavelength for phototherapies including but not limited to blocking filters of 340 nm and less for lupus therapy. The luminous nanocrystals are capable of emitting a tuned range of wavelengths which eliminates the need for filters and increases the efficiency of the light provisioning system arbitrary wavelength ranges.

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Witness: Chris Gerweir Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 56

A further embodiment of the present invention incorporating an LED based teeth whitener means, wherein said LED based teeth whitener means is comprised of combinations of components including but not limited to a teeth whitener light source means (typically a plurality of LEDs with one or more wavelength including but not limited to UV light emitting diodes with wavelength of 395 nm), a light mixing means (when more than a single wavelength LED is incorporated), a teeth whitener enclosure means (with substantially opaque walls and with translucent interior and with one or more UV translucent openings arranged so as to protect skin and gums while exposing teeth to phototherapy), a teeth whitener fit detection means (including proximity safety switches on said teeth whitener enclosure means and on said UV eyewear protection means to determine proper fit of both the UV protection eyewear and the teeth whitener enclosure), a teeth whitener power supply means (low voltage with at least one national certification or international certifications, for example in the USA a UL approved rating), a teeth whitener electric current overdrive control means (for reducing the required number of LEDs), a teeth whitener light measurement means (used to determine imminent failures or feedback to current control means in the case of reduced luminous power over time), a teeth whitener memory (to determine life and usage patterns), a teeth whitener microcontroller (e.g. MC68CH11 with ROM, RAM and FLASH), teeth whitener microcontroller operating programs, a teeth whitener active junction temperature environmental control means, a teeth whitener light source cooling means, a teeth whitener control means (with operation lockout features), a teeth whitener communications means (for connecting proximity sensors), a teeth whitener timer means (with maximums and responsive to logic in the case of a poor fit restart of a single session), a battery (for portable operation) useful for the purpose of teeth brightening teeth with reduced hazards. Wherein said operation lockout control means is responsive to said wherein said dental light directing means is commercially available and sold under the name "Twilight Teeth" UV light catchers used in combination with UV LED for the adaptation of the commercially available tooth brightener, where said UV LED includes but is not limited to UV light emitting diodes, wherein UV light emitting diode includes but is not limited to UV-395-TO92 manufactured by Bivar Corp, Irvine, California, USA, to NSHU550A manufactured by Nichia USA, and to LC503MUV1-30Q a 5 mm t-1 3/4 package from Marktech Optoelectronics, Menands, New York, USA. A

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Witness: Robert Kuehler Date: 3/9/2004
Witness: Chris Gessner Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 57

method for customizing said

A further embodiment of the present invention incorporating an LED based hair growth assistance means, wherein said LED based hair growth assistance means is comprised of combinations of components including but not limited to a hair growth assistance light source means (typically a plurality of LEDs with one or more wavelength including but not limited to UV light emitting diodes with wavelength of 395 nm), a light mixing means (when more than a single wavelength LED is incorporated), a hair growth assistance enclosure means (with substantially opaque walls and with translucent interior and with one or more UV translucent openings arranged so as to protect skin and gums while exposing teeth to phototherapy), a hair growth assistance fit detection means (including proximity safety switches on said hair growth assistance enclosure means and on said UV eyewear protection means to determine proper fit of both the UV protection eyewear and the hair growth assistance enclosure), a hair growth assistance power supply means (low voltage with at least one national certification or international certifications, for example in the USA a UL approved rating), a hair growth assistance electric current overdrive control means (for reducing the required number of LEDs), a hair growth assistance light measurement means (used to determine imminent failures or feedback to current control means in the case of reduced luminous power over time), a hair growth assistance memory (to determine life and usage patterns), a hair growth assistance microcontroller (e.g. MC68CH11 with ROM, RAM and FLASH), hair growth assistance microcontroller operating programs, a hair growth assistance active junction temperature environmental control means, a hair growth assistance light source cooling means, a hair growth assistance control means (with operation lockout features), a hair growth assistance communications means (for connecting proximity sensors), a hair growth assistance timer means (with maximums and responsive to logic in the case of a poor fit restart of a single session), a battery (for portable operation) useful for the purpose of teeth brightening teeth with reduced hazards. Wherein said operation lockout control means is responsive to said wherein said hair growth assistance light source means is not presently commercially available. Said UV LED includes but is not limited to UV light emitting diodes, wherein UV light emitting diode includes but is not limited to UV-395-TO92 manufactured by Bivar Corp, Irvine, California, USA, to NSHU550A

Inventor: Peter Depew Fiset Date: 03/09/2004
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Witness: Louis Giuliano Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 58

manufactured by Nichia USA, and to LC503MUV1-30Q a 5 mm t-1 3/4 package from Marktech Optoelectronics, Menands, New York, USA. A method for customizing said

A further embodiment of the present invention incorporating general purpose enclosure means capable of use in multiple phototherapy procedures including but not limited to teeth whitening phototherapy, hair growth assistance phototherapy, and pattern tanning. Wherein general purpose enclosure means incorporates configurable components including but not limited to adapters, connectors, UV opaque flexible shrouds, configurable microcontroller, general purpose enclose state detection means, and UV translucent light pipes configurable components adaptable to specific phototherapies prior to use. Said configurable microcontroller responsive to said general purpose enclosure state detection means for the useful purpose including but not limited to providing suitable controls to appropriate for current phototherapy configuration.

A further embodiment of the present invention incorporates the use of teeth whitener chemical enhancement means including but not limited to Carbamide Peroxide.

A further embodiment of the present invention incorporates the use of hair growth assistance chemical enhancement means including but not limited to minoxodil.

A further method of the present invention sequences wavelength in a manner that produces greater results than without sequencing wavelengths.

A further method of the present invention sequences power variations for wavelengths in a manner that produces greater results than without sequencing wavelengths.

A further embodiment of the present invention incorporating pulsed jet cooling techniques to lower the thermal resistance at the bondary layers of the LED.

The drawings are numbered using page No. and lower case letter sequentially starting with the letter "a", for example the first

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Witness: Chris Gessner Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 59

figure is on page 1 is labeled 1a, and the second figure on page 3 is labeled 3b.

DRAWINGS

Figure 1a shows an embodiment of the present invention incorporating liquid holes for liquid flow and refrigerant expansion, LED array, assembled using the chip on board method.

Fig. 2a shows an embodiment of the invention with hermetically sealed enclosure with vapor condenser, heat sink, liquid pump, power supply and control system with LED array wherein he mode of operation uses forced convection.

Fig. 2b shows an embodiment of the invention with hermetically sealed enclosure with vapor condenser, heat sink, liquid pump, power supply, temperature, pressure, flow, and control system with LED array wherein he mode of operation uses forced convection.

Fig. 3a shows an embodiment of the invention with hermetically sealed enclosure with vapor condenser, integral heat sink, liquid pump, power supply and control system with LED array wherein he mode of operation uses forced convection.

Fig. 3a shows an embodiment of the invention with hermetically sealed enclosure with vapor condenser, integral heat sink, power supply and control system with LED array wherein he mode of operation uses natural convection.

Fig. 4a shows the pigmentation response action spectra for UV light.

Fig. 4b shows the Non-melanoma carcinogenesis action spectra for UV light.

Fig. 4c shows a calculation for optimum wavelength selection for silicon carbide based LEDs.

Fig. 5a shows the discrete cooling cost versus change in temperature reflecting the need for additional refrigeration units the

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Witness: Chris Gesbrecht Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 60

lower the temperature required.

Fig. 5b. shows the cost of LED decreases as the temperature of cooling increases.

Fig. 5c shows the accumulated cost as a function of temperature of cooling increases.

Fig. 5d shows the cost of energy for levels of cooling.

Fig. 6a shows isometric lines of overdrive current versus logarithmic life and active junction temperature.

Fig. 6b shows a typical wavelength shift versus temperature.

Fig. 7a shows a refrigeration process with LED array, see numerals listed in NUMERALS section.

Fig. 7b shows a typical printed wiring board with chip on board LED, open frame LED, and encapsulated LED, see numerals listed in NUMERALS section.

Fig. 7c shows an refrigerant expansion hole and a ventilation hole in proximity to LED.

Fig. 7d shows multiple refrigerant expansion holes and a ventilation hole in proximity to LED.

Fig. 7e shows a refrigeration expansion tube within a translucent lens in direct proximity to LED wherein the flow is such that the cold refrigerant move across the surface of the LED in a efficient manner with regards to heat transfer.

Fig. 7d shows a refrigeration expansion tube within a translucent lens in direct proximity to LED wherein the flow is such that the cold refrigerant move across the surface of the LED in a efficient manner with regards to heat transfer and includes LED enclosure and lens.

Fig. 8a shows an installation of multiple phototherapy chamber sharing a sing light source where the sharing means is a mechanical

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Witness: Ernest Gessner Date: 3/12/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 61

translation system within light pipes.

Fig. 8b shows an installation of multiple phototherapy chamber sharing a sing light source where the sharing means is a fiber optic light distribution system system within light pipes.

Fig. 9a shows a rough encapsulant for use with nucleate boiling.

Fig. 9b shows a method of producing a rough surface for nucleate boiling.

Fig. 9c shows a method of producing a rough surface for nucleate boiling with Step 1 with an encapsulant with a micro beads transparent to UV light, Step 2 mechanical abrasion, Step 3 with chemical etching where the chemical attacks the micro beads to form nucleate boiling sites.

Fig. 10a shows fastening means required to attach LED array to a phototherapy chamber using fasteners.

Fig. 10b shows fastening means required to attach LED array to a phototherapy chamber using external straps.

Fig. 11a shows patient receiving a hair growth assistance phototherapy.

Fig. 12a shows a reduced encapsulant LED for reduce thermal resistance made from a standard LED.

Fig. 13a shows the front view of a teeth whitener means.

Fig. 13b shows a cutout top view of a teeth whitener means.

Fog. 13c shows a process by which a teeth whitener means is customized to a patients teeth by a professional.

Fig. 14a shows a power supply for LEDs.

Fig. 15a, 15b, and 15c show variations in the power supply for LEDs.

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Witness: Chris Pressler Date: 3/9/2004

Provisional Patent Application of Peter Depew Fiset for "Skin Indoor tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid" continued - Page 62

Fig. 16a shows a direct line voltage power supply that has a useful near unity power factor LED transfer function which is useful to remove the need for a switching power supply utilizing resistor ladder network to creates bias for transistors.

Fig. 17a shows a direct line voltage power supply that has a useful near unity power factor LED transfer function which is useful to remove the need for a switching power supply utilizing resistor ladder network to creates bias for transistors.

Fig. 18a shows a first stage of a light source sharing means using a linear translation for first phototherapy chamber.

Fig. 18b shows a second stage of a light source sharing means using a linear translation for second phototherapy chamber.

Fig. 18c shows a first stage of a light source sharing means using a rotational translation for first phototherapy chamber.

Fig. 18d shows a second stage of a light source sharing means using a rotational translation for second phototherapy chamber.

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Inventor: Peter Depew Fiset Date: 03/09/2004
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Witness: Robert Kachler Date: 3/9/2004
Witness: Marc Gessner Date: 2/9/2004

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INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

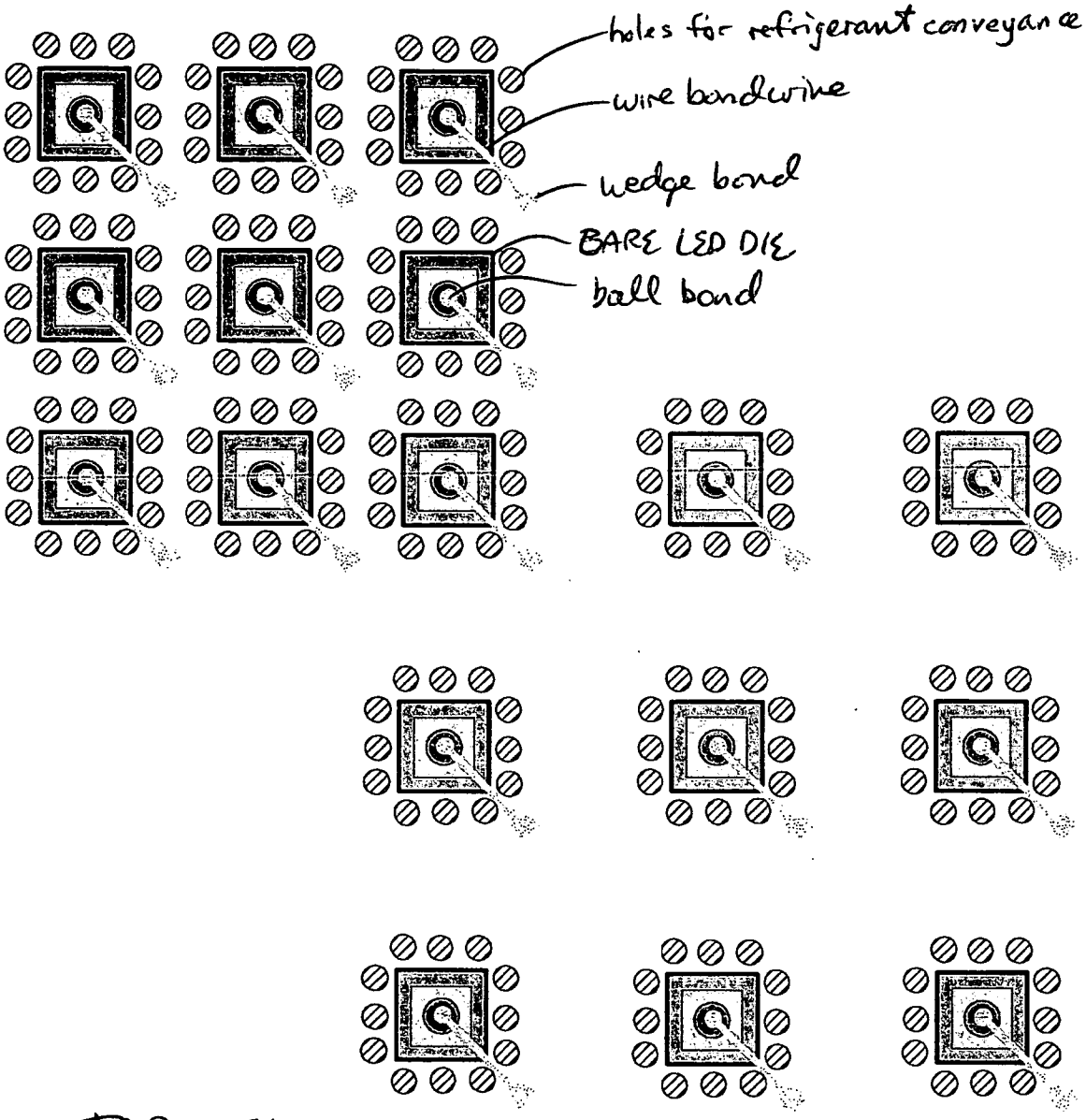

FIG. 1a

Inventor: Peter Depew Fiset

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Witness: Robert Kuehler Date: 3/9/2004

Witness: Dennis Gressler Date: 3/9/2004

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TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

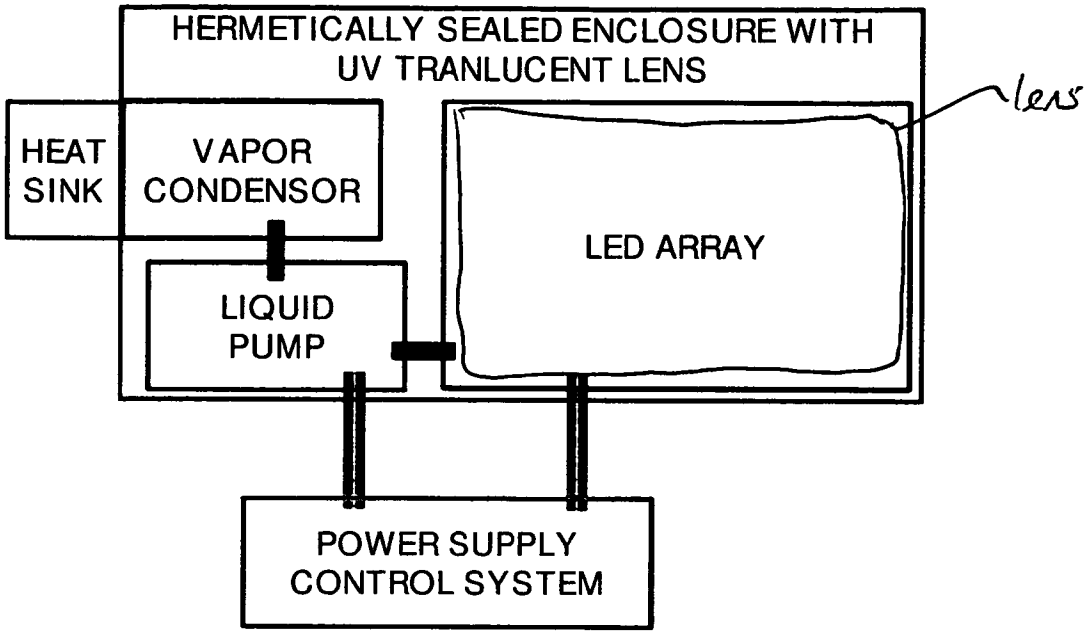

FIG. 2a

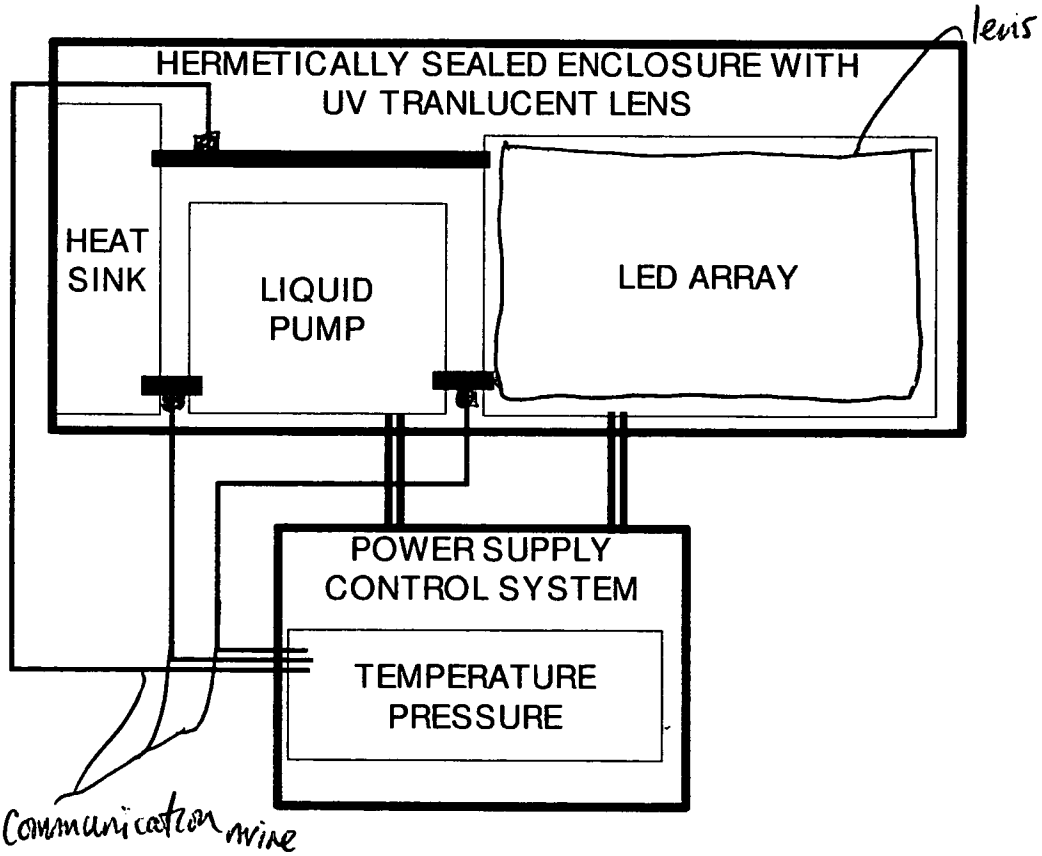

FIG. 2b

Inventor: Peter Depew Fiset Date: 03/09/2004

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Witness: Robert Kuehler Date: 3/9/2004

Witness: Chris Kessler Date: 3/9/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

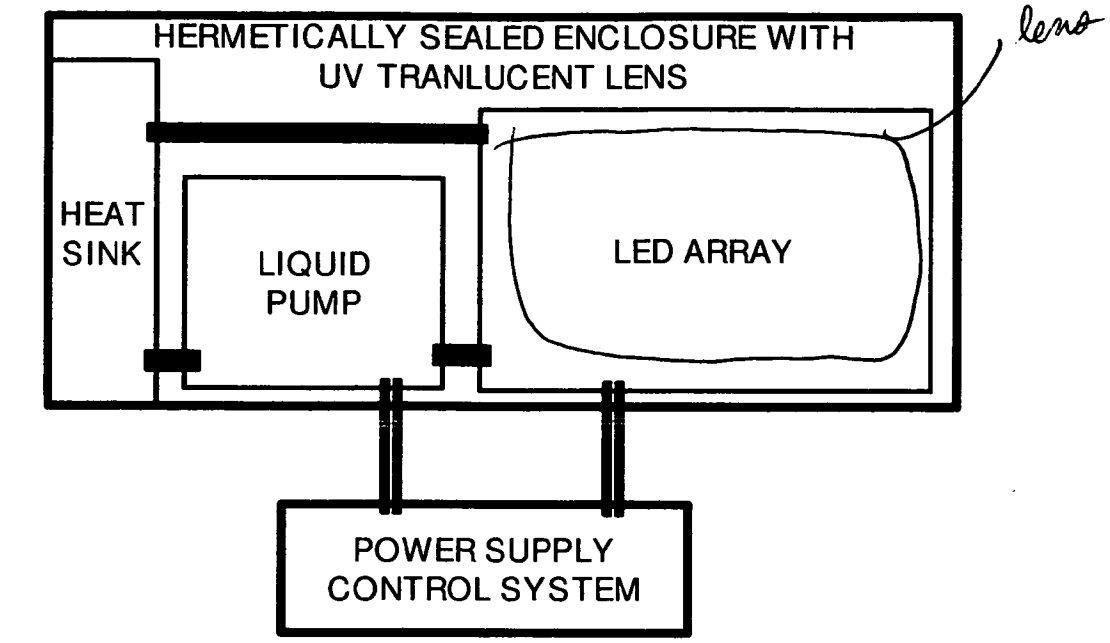

FIG. 3a

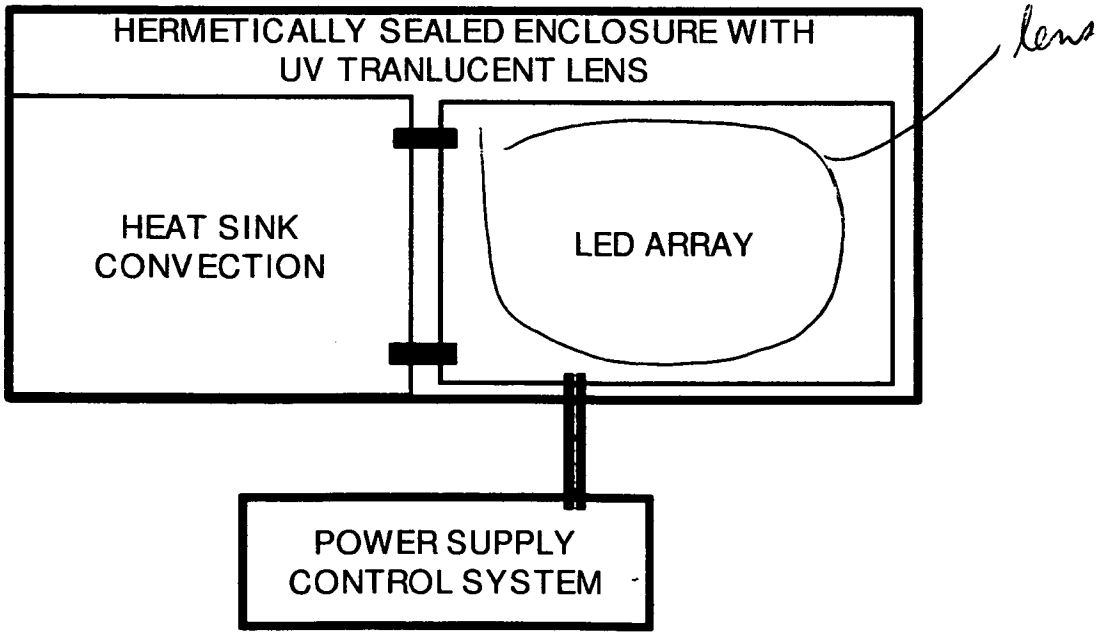

FIG. 3b

Inventor: Peter Depew Fiset Peter Depew Fiset Date: 03 / 09 / 2004

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Witness: Robert Kuehler Robert Kuehler Date: 3 / 9 / 2004

Witness: Chris Geissler Chris Geissler Date: 3 / 9 / 2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

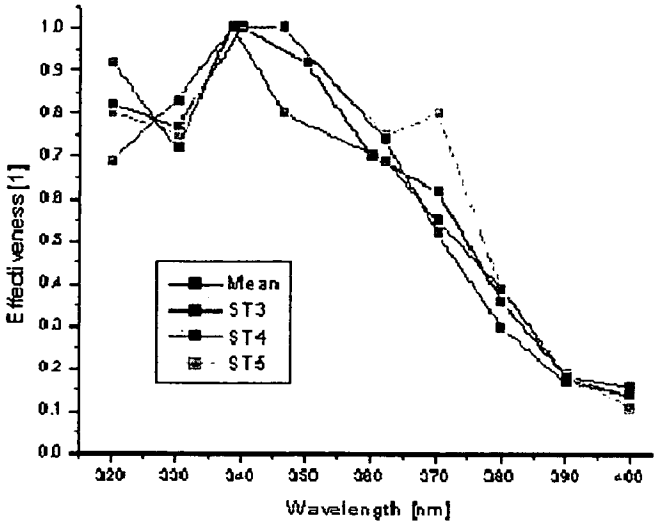

FIG. 4a

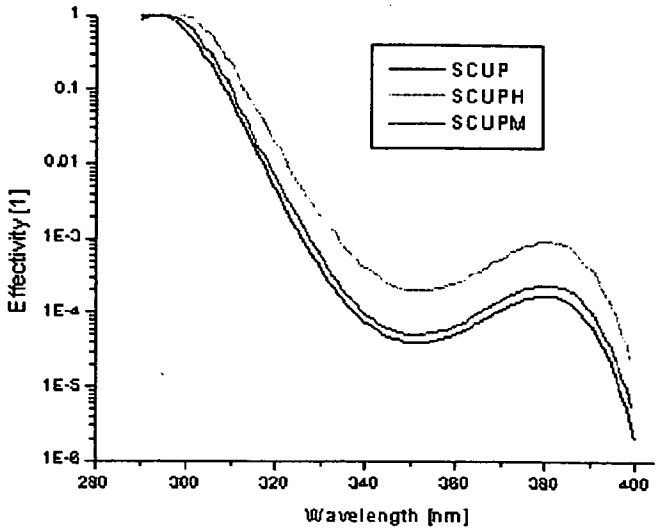

FIG. 4b

LED Wavelength (nm) (L)	Per LED Power (mw) (See NOTE1) (P)	Rel. Activity (Pigment.) (TE)	**Rel. Eff. Tanning Power** **=(P)*(TE)**	Rel. Activity (Carcinogen.) (CE)	**Activity per Rel. Eff. Tan. (Carcinogen.)** **=(CE)/(TE)**	Comment
345	1.0	0.95	**0.95**	0.000040	**0.000042**	
350	1.5	0.90	**1.35**	0.000030	**0.000033**	Least Hazard
355	2.0	0.80	**1.60**	0.000040	**0.000050**	
360	2.5	0.75	**1.88**	0.000050	**0.000067**	
365	3.0	0.70	**2.10**	0.000070	**0.000100**	
370	4.0	0.60	**2.40**	0.000100	**0.000167**	Least Power
375	5.0	0.45	**2.25**	0.000200	**0.000444**	
380	6.0	0.35	**2.10**	0.000300	**0.000857**	
385	8.0	0.25	**2.00**	0.000200	**0.000800**	
390	11.0	0.20	**2.20**	0.000070	**0.000350**	
395	15.0	0.15	**2.25**	0.000020	**0.000133**	

FIG. 4c

Inventor: Peter Depew Fiset Date: 03/09/2004

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Witness: Robert Kuehler Date: 3/9/2004

Witness: Chris Gessner Date: 3/9/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

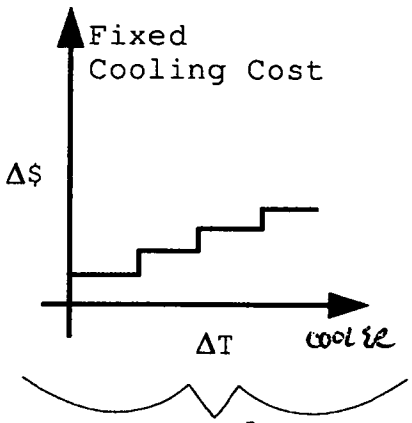

FIG. 5a

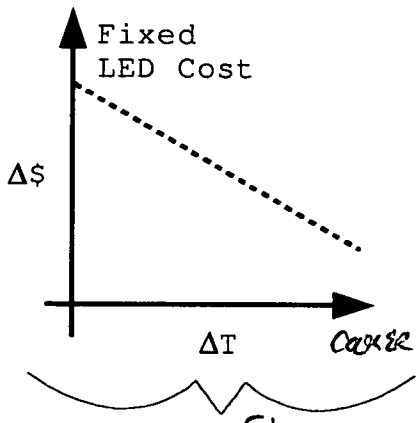

FIG. 5b

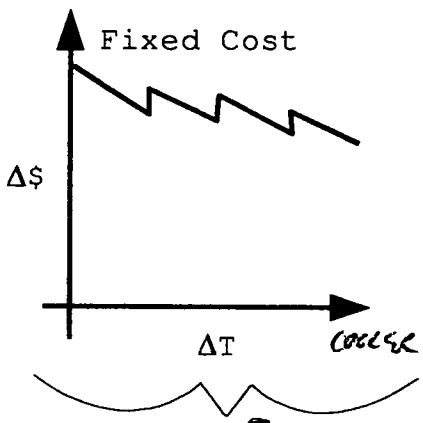

FIG. 5c

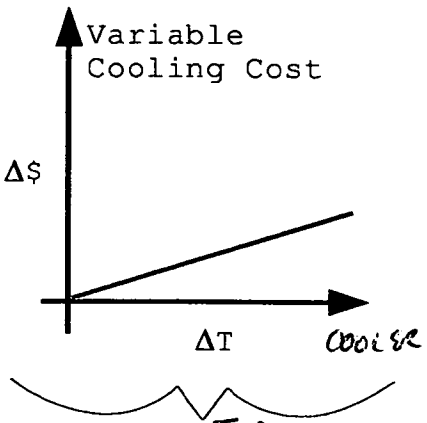

FIG. 5d

Inventor: Peter Depew Fiset Date: 03 / 02 / 2004

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Witness: Robert Kuehler Date: 3 / 1 / 2004

Witness: Chris Gessner Date: 3 / 2 / 2004

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TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

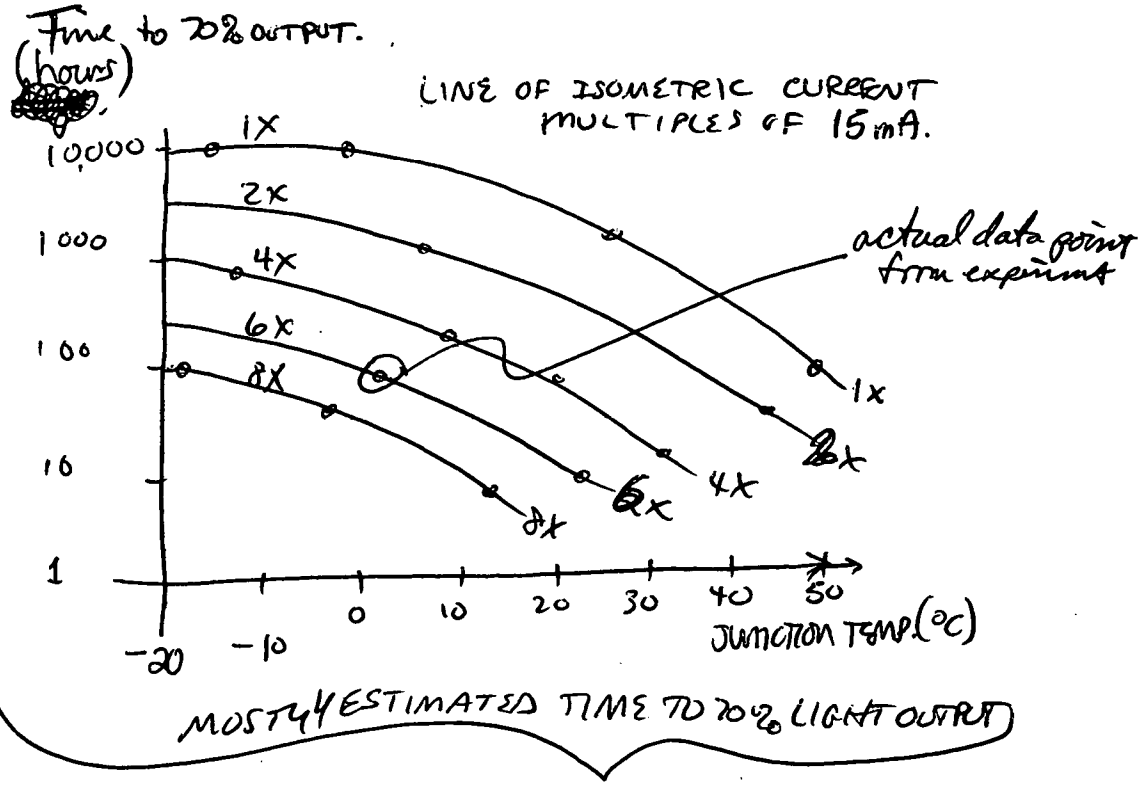

FIG. 6a

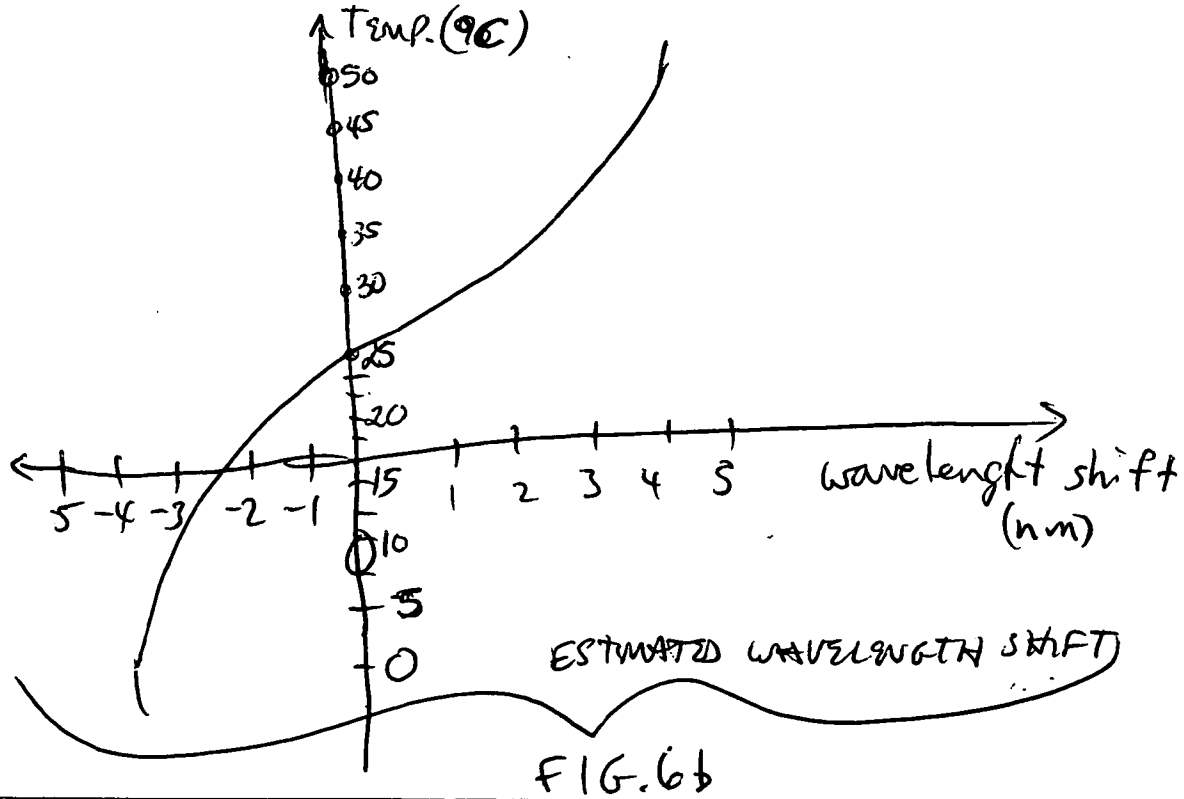

FIG. 6b

Inventor: Peter Depew Fiset

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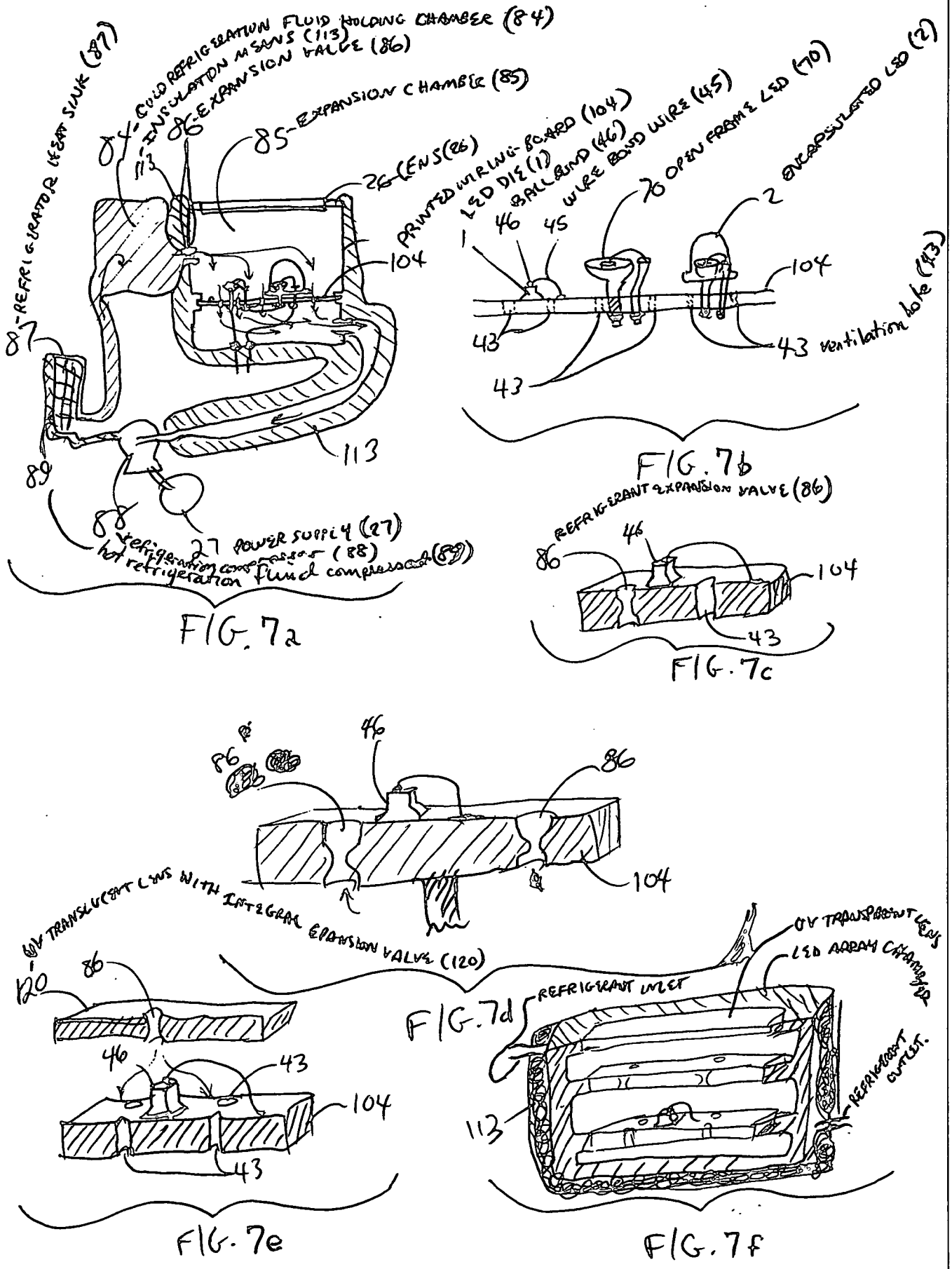
Witness: Robert Kiehler Date: 3/9/2004

Witness: Claus Gessler Date: 3/9/2004

Peter Depew Fiset Date: 03/09/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



Inventor: Peter Depew Fiset Date: 03 / 03 /2004

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Witness: Robert Kalmer Date: 3 / 9 /2004

Witness: Claus Gerhardt Date: 3 / 9 /2004

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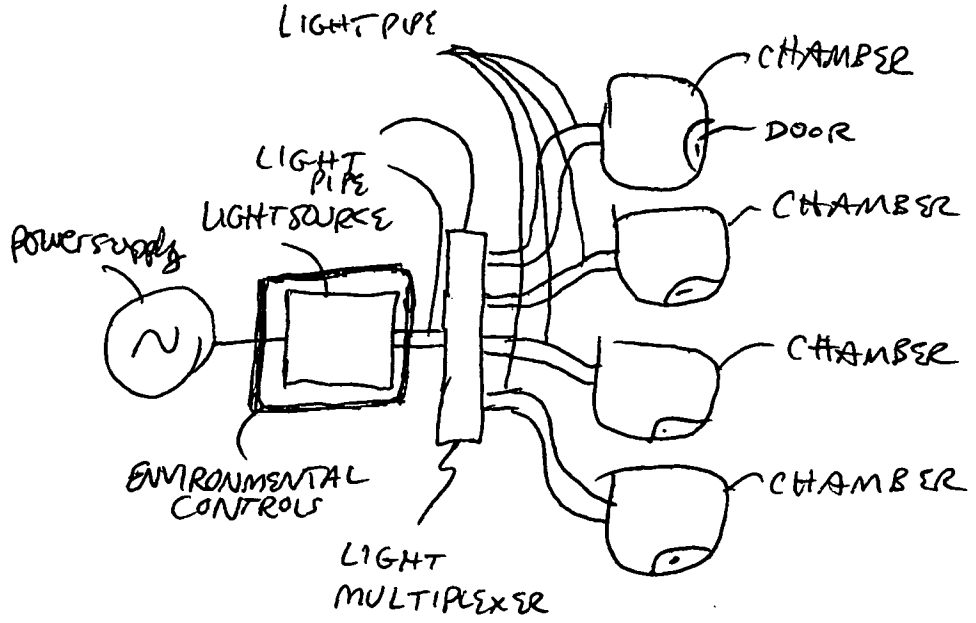
TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



TOP VIEW

FIG. 8a

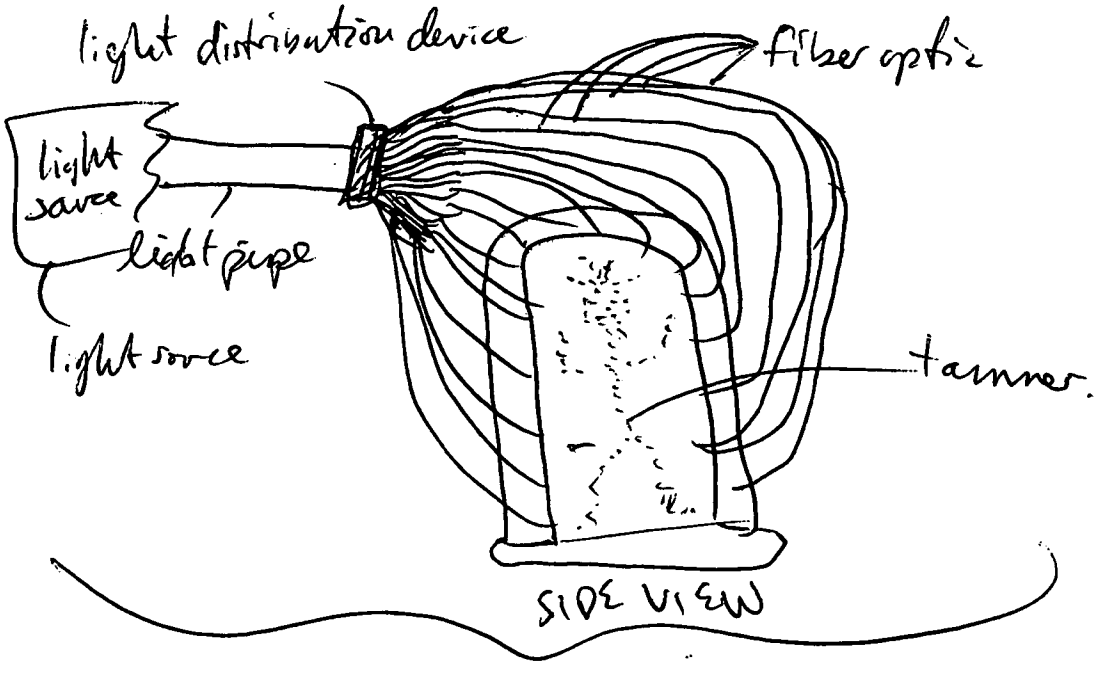


FIG. 8b

Inventor: Peter Depew Fiset Date: 03 / 08 / 2004

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Witness: Robert Kuehner Date: 3 / 9 / 2004

Witness: Chris Gessner Date: 3 / 9 / 2004

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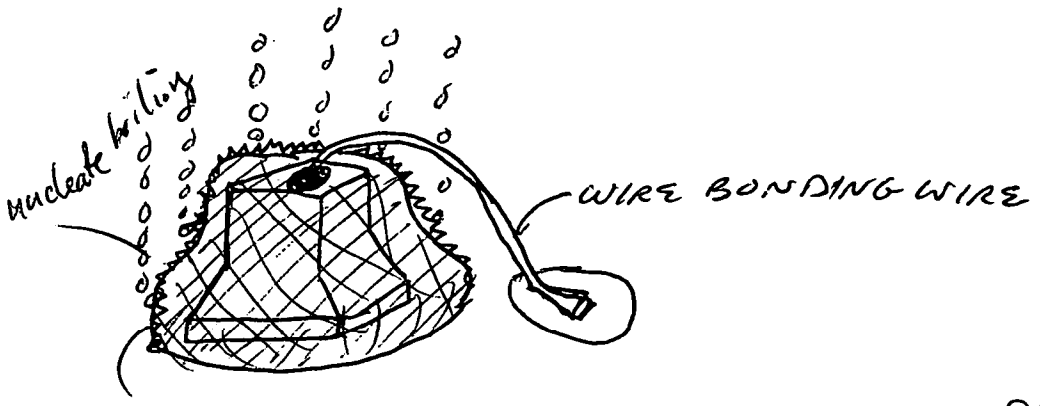
TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



ROUGH ENCAPSULANT FOR NUCLEATE BOILING

FIG. 9a

- METHOD OF PITTING.
  1. Chemical
  2. Mechanical Abrasion.
  3. Combination
  4. Add micro beads the will be etched.

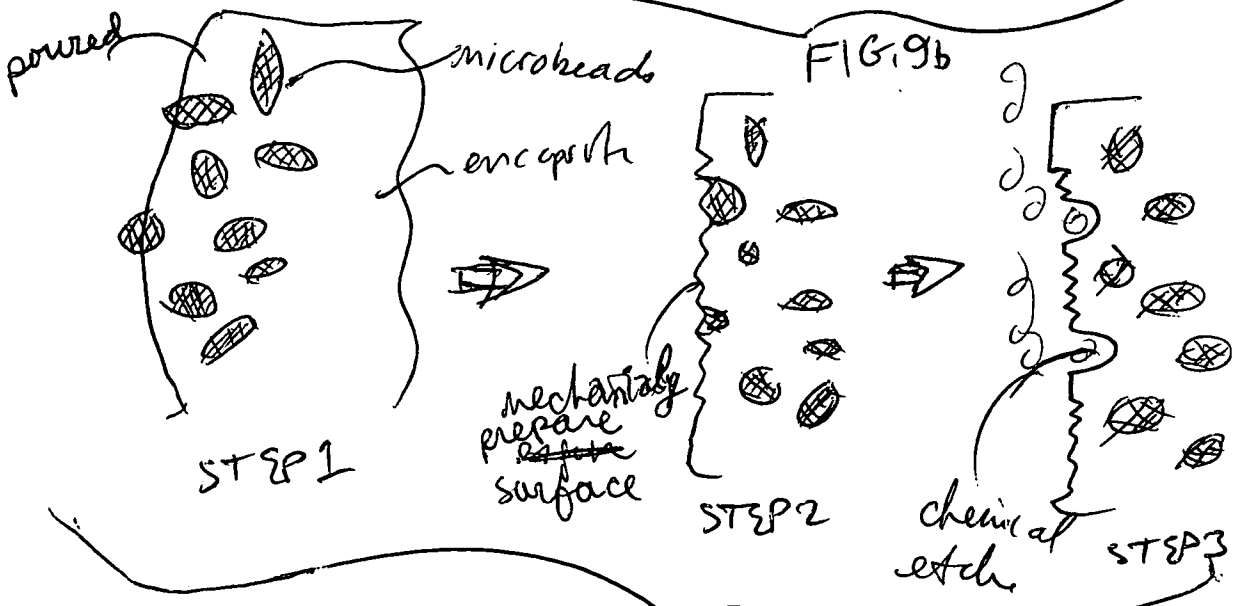


FIG. 9b

FIG. 9c

Inventor: Peter Depew Fiset Peter Depew Fiset Date: 03/03/2004

I agree not to disclose the above confidential information which I have witnessed and understood (print name, sign & date-MM/DD/YYYY)

Witness: Robert Koehler Robert Koehler Date: 3/9/2004

Witness: Chris Gerstner Chris Gerstner Date: 3/9/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

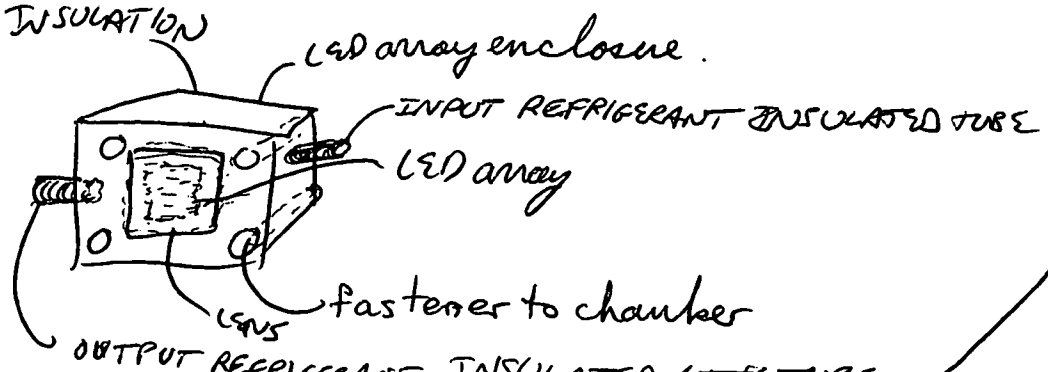


FIG. 10a

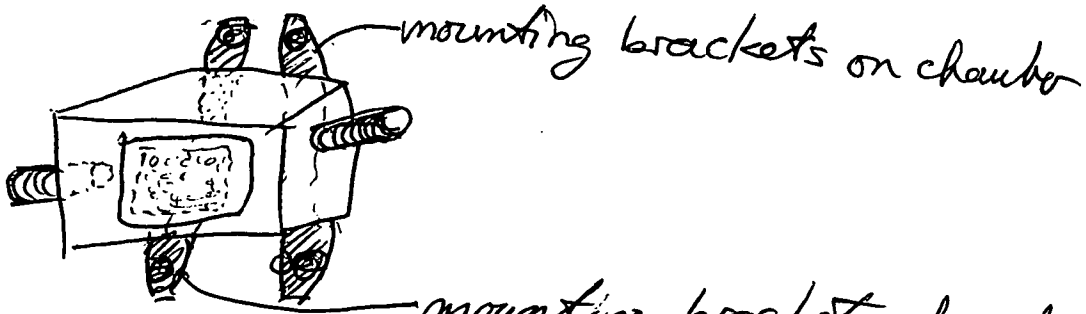


FIG. 10b

Inventor: Peter Depew Fiset

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date--MM/DD/YYYY)

Witness: Robert Kuehler Date: 3 / 9 / 2004

Witness: Louis Gessner Date: 3 / 9 / 2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

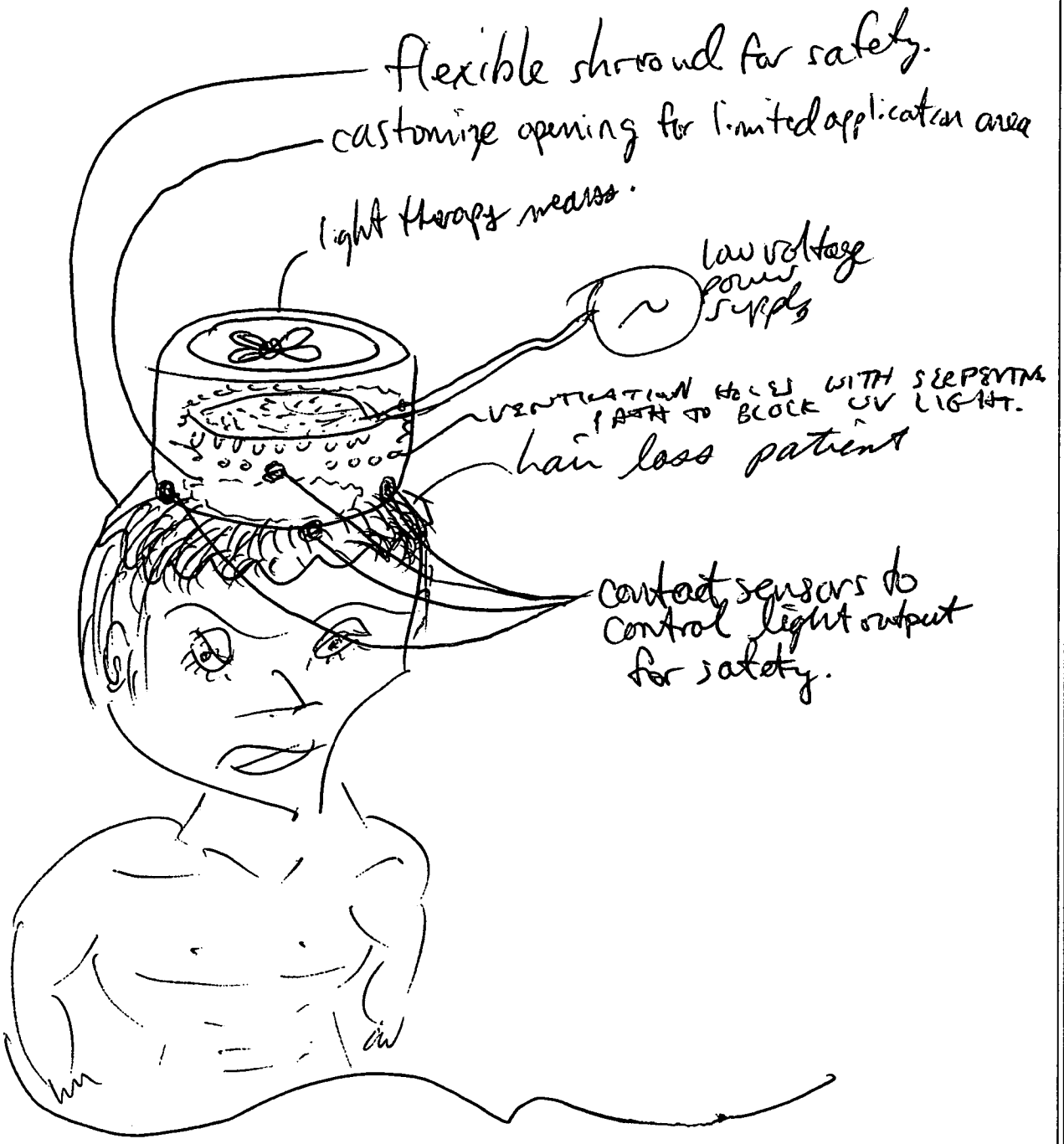


FIG. 11a

Inventor: Peter Depew Fiset

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date--MM/DD/YYYY)

Witness: Robert Kaehler Date: 3/9/2004

Witness: Chris Kershner Date: 3/2/2004

Peter Depew Fiset Date: 03/02/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

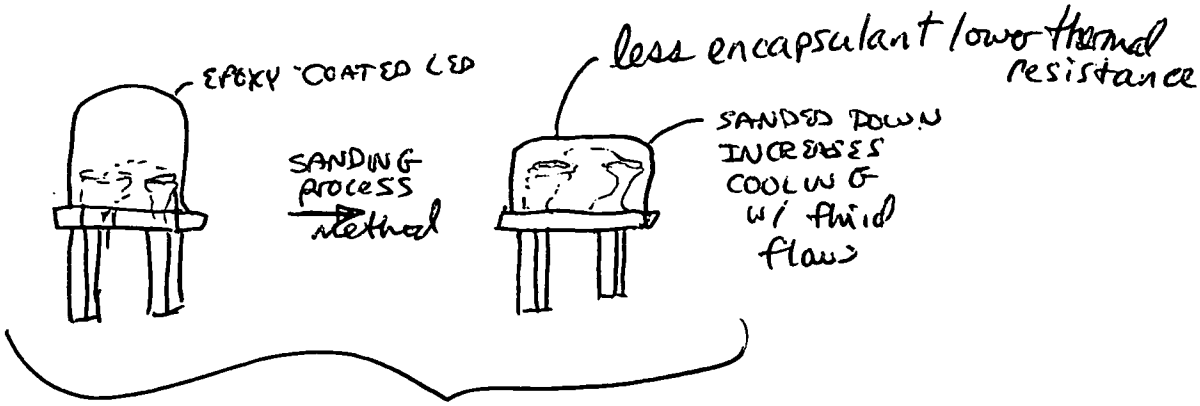


FIG. 12a

Inventor: Peter Depew Fiset

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date--MM/DD/YYYY)

Witness: Robert Kaehler Date: 3 / 8 /2004

Witness: Thomas Gessweiz Date: 3 / 9 /2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

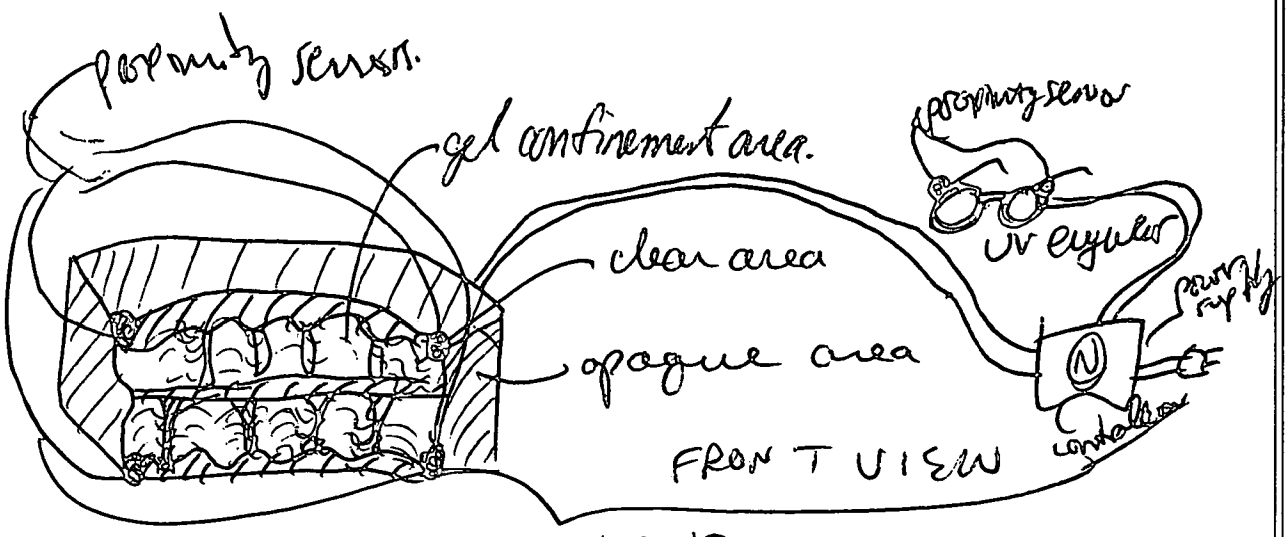


FIG. 13a

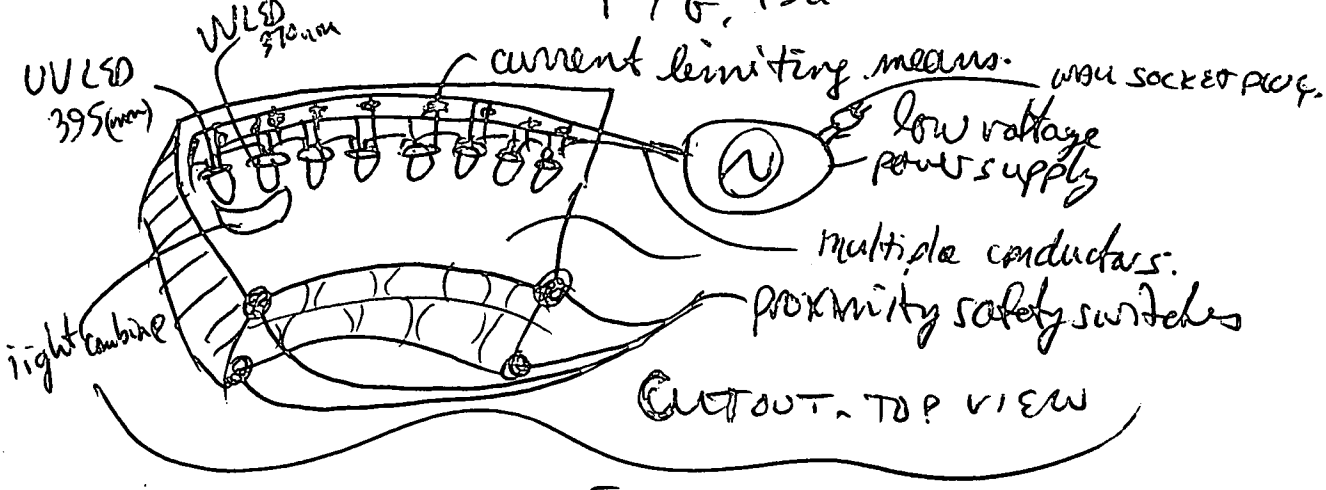


FIG. 13b

METHOD TO CREATE PERSONAL TEETH WHITENER

1. CHEMICAL ETCH, PROFESSIONAL;
2. MOLD, CURE, THEN CUT FELT WHERE TEETH ARE EXPOSED.
3. BITE INTO MOLD FORM BITE, CURE, CUT AWAY OPAQUE SHIELD AT TEETH OUTLINE.

FIG. 13c

Inventor: Peter Depew Fiset Date: 03/09/2004

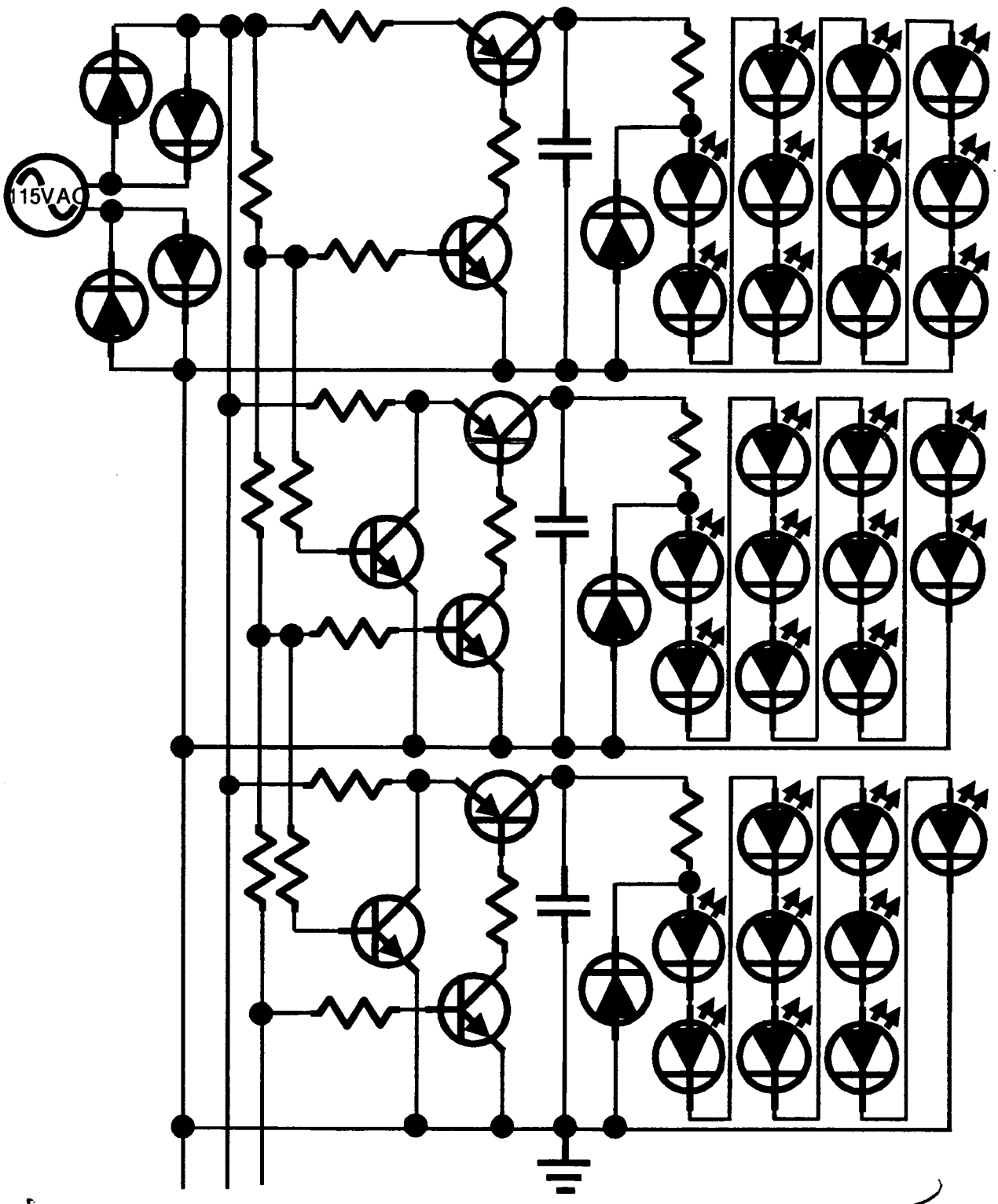
I agree not to disclose the above confidential information which I have witnessed and understood (print name, sign & date-MM/DD/YYYY)

Witness: Robert Kaehler Date: 3/8/2004

Witness: Chris Gross Date: 3/9/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



14a

Inventor: Peter Depew Fiset

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date-MM/DD/YYYY)

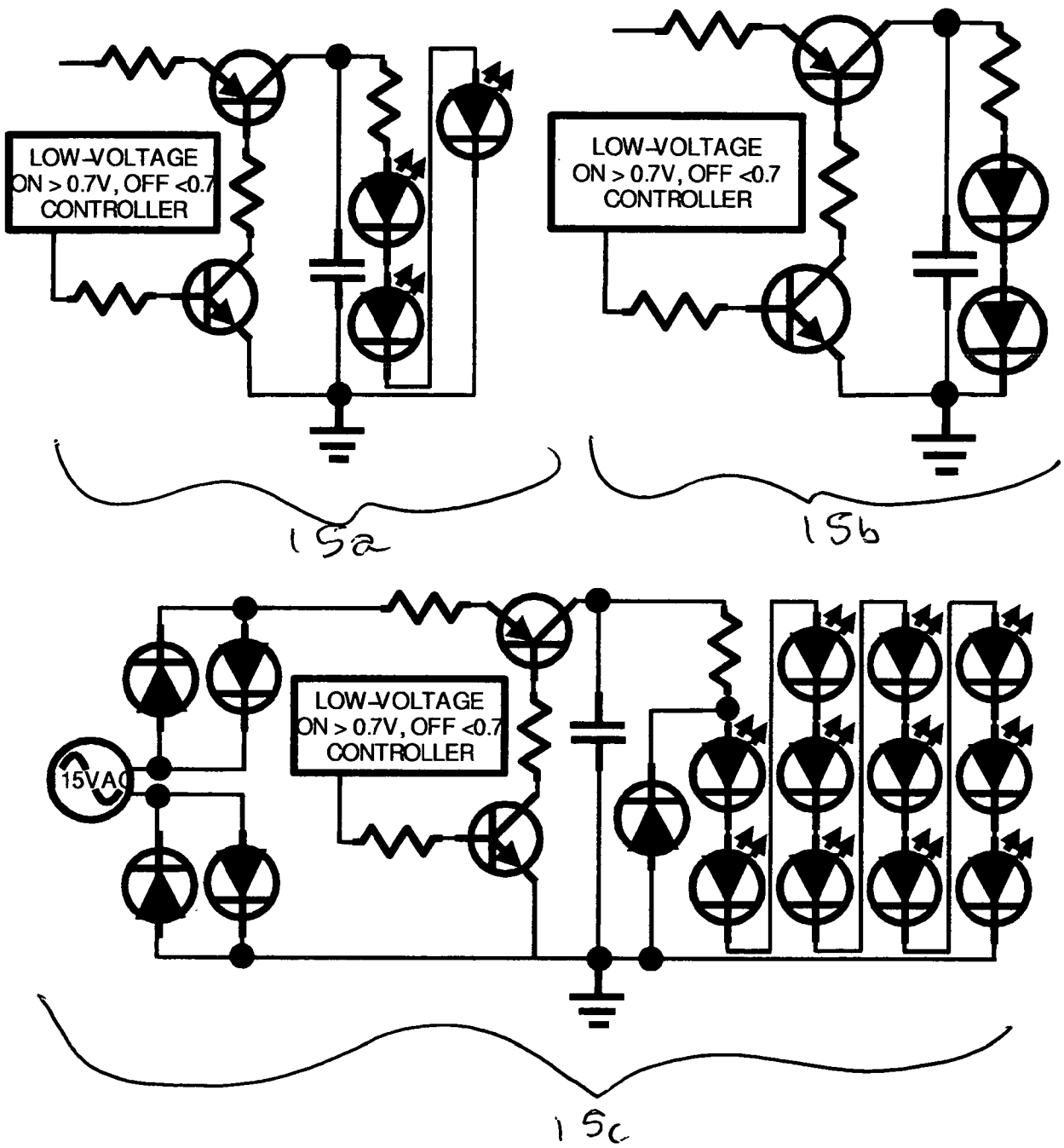
Witness: Robert Kashler Date: 3/9/2004

Witness: Hans Gerwer Date: 3/9/2004

Peter Depew Fiset Date: 03/09/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



Inventor: Peter Depew Fiset

I agree not to disclose the above confidential information which I have witnessed and understood (print name, sign & date-MM/DD/YYYY)

Witness: Robert Koehler Date: 03/02/2004

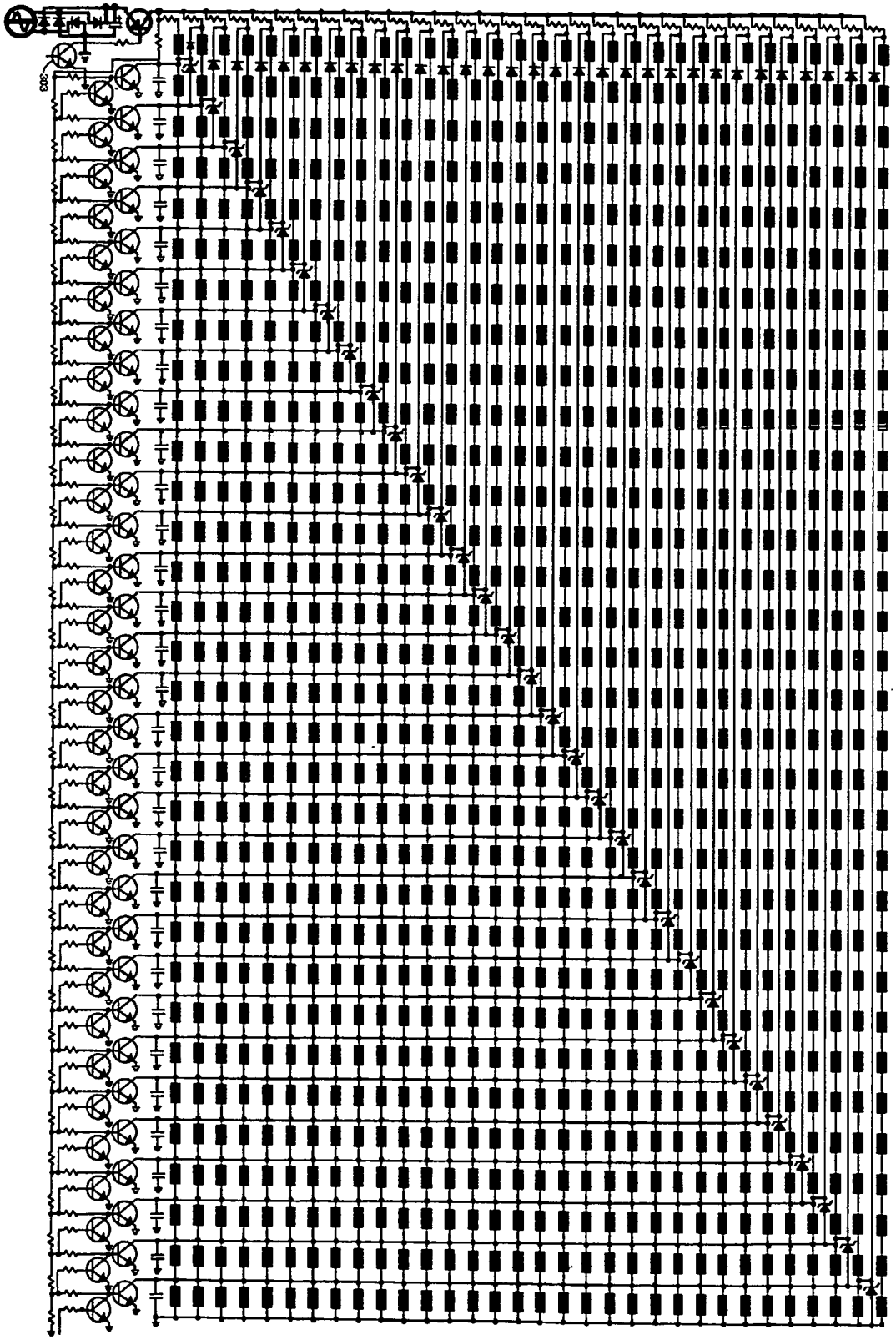
Witness: Chris Gessner Date: 3/9/2004

Witness: Peter Depew Fiset Date: 3/9/2004

INVENTION DISCLOSURE **CONFIDENTIAL** Drawing Sheet 16 of 18

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



162

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date-MM/DD/YYYY)

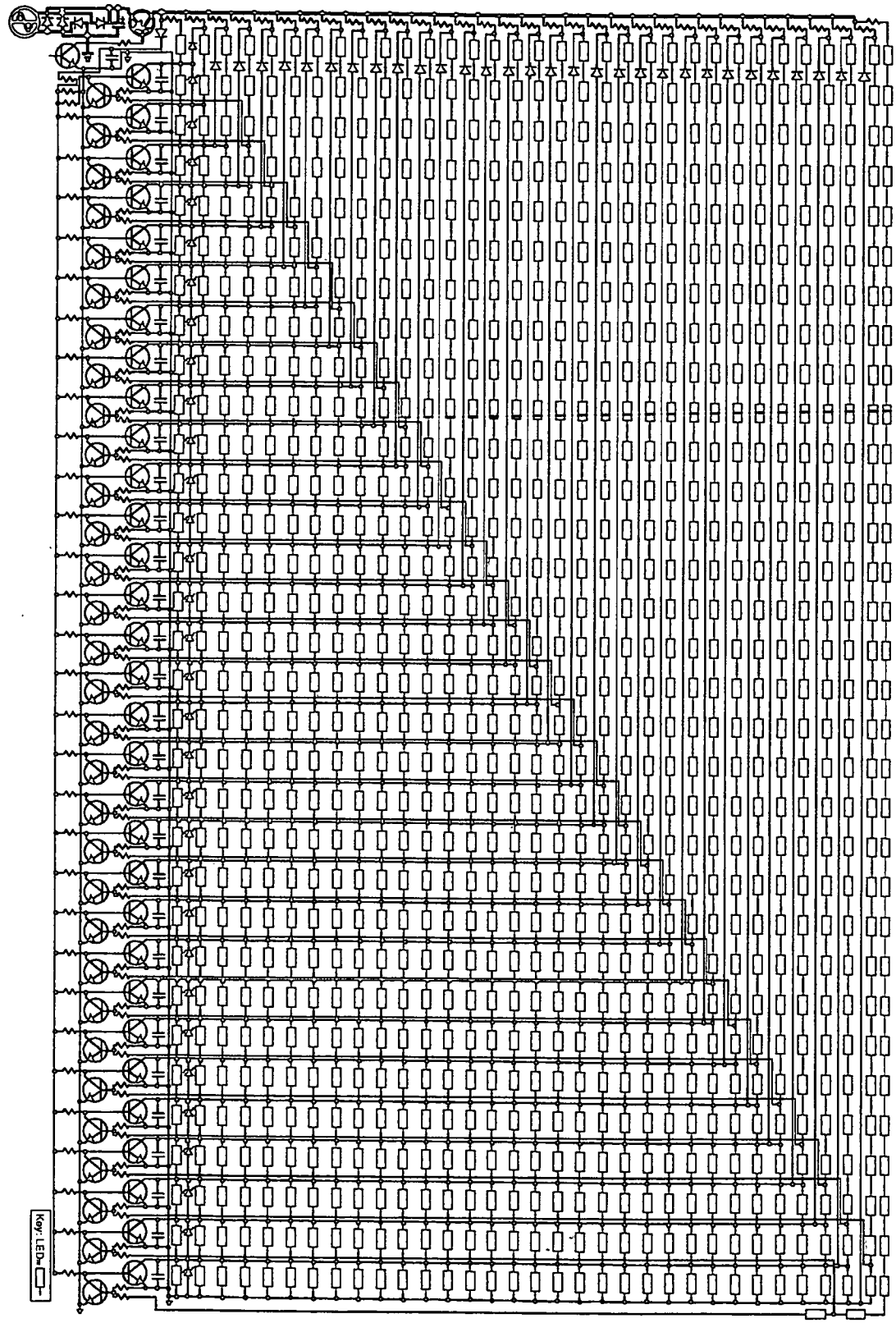
Inventor: Peter Depew Fiset Peter Depew Fiset Date: 03 / 09 / 2004

Witness: Robert Kuehler Robert Kuehler Date: 3 / 9 / 2004

Witness: Chris Gfesser Chris Gfesser Date: 3 / 9 / 2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211–1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"



17a

Inventor: Peter Depew Fiset Peter D. Fiset Date: 08/02/2004

I agree not to disclose the above confidential information which I have witnessed and understood. (print name, sign & date-MM/DD/YYYY)

Witness: Robert Kaehler Robert Kaehler Date: 8/9/2004

Witness: Chris Gerstner Chris Gerstner Date: 8/9/2004

INVENTOR: Peter Depew Fiset, 5 Upper Loudon Road, Loudonville, NY, USA 12211-1635

TITLE OF INVENTION: "Skin Tanning and Light Therapy Incorporating Light Emitting Devices and Cooling Fluid"

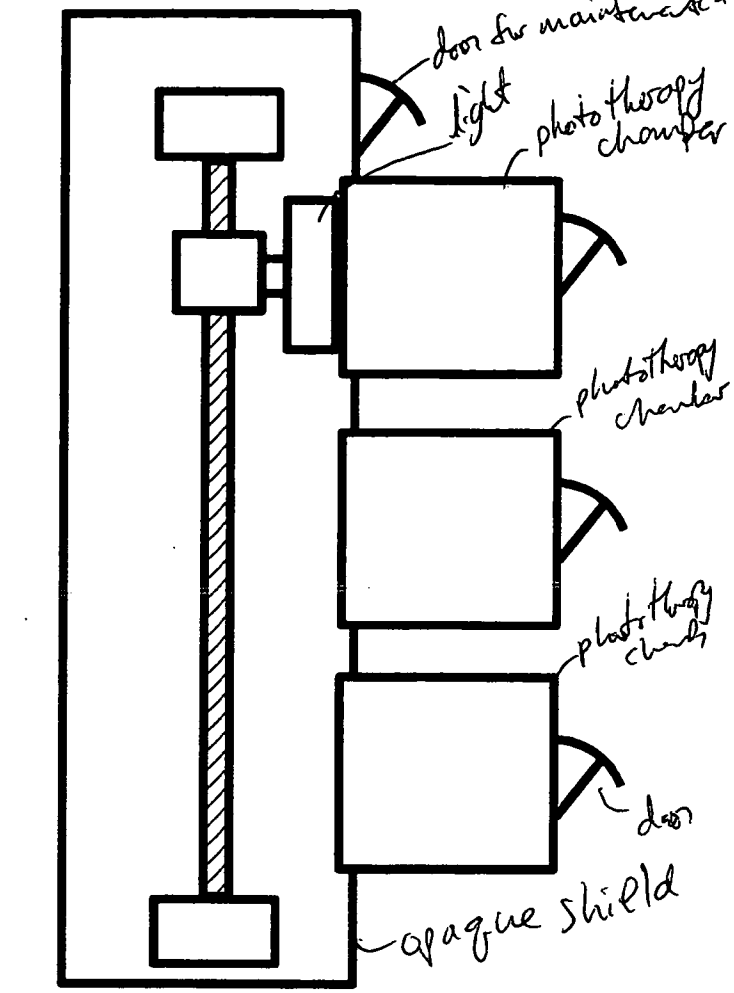


FIG. 18a

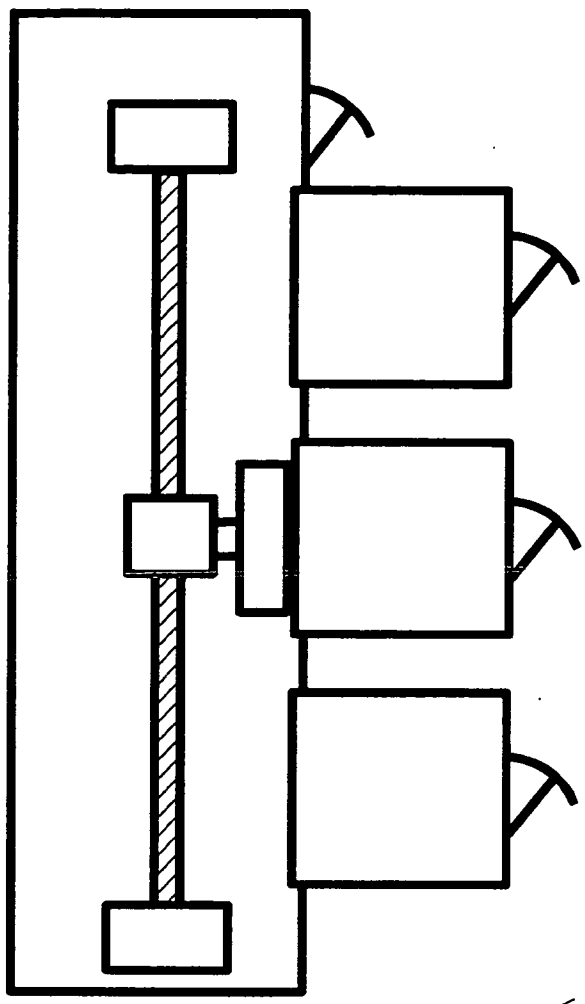


FIG. 18b

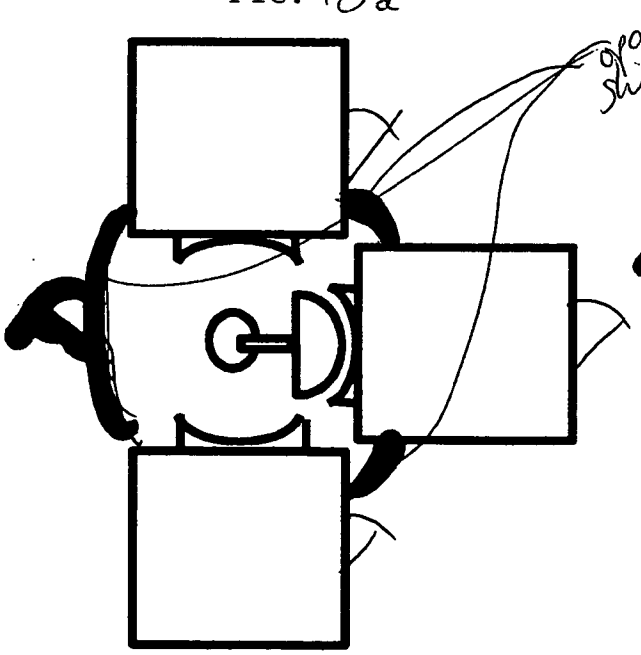


FIG. 18c

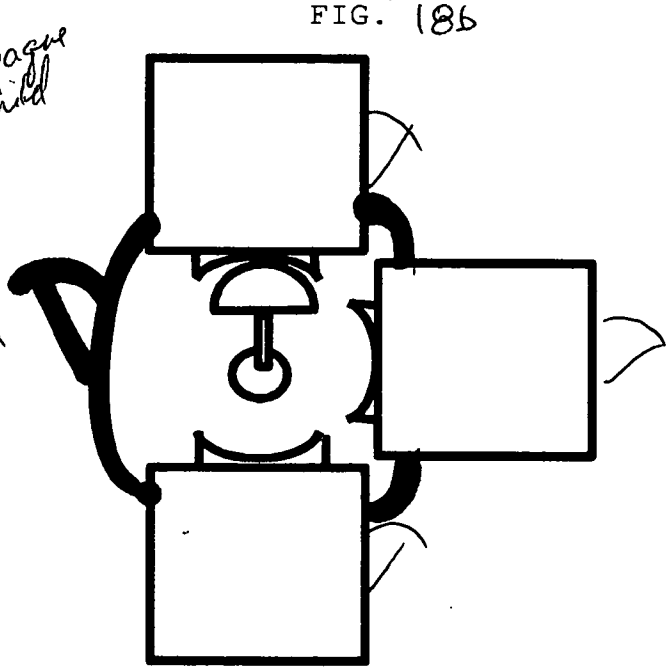


FIG. 18d

Inventor: Peter Depew Fiset Date: 12/02/2004

I agree not to disclose the above confidential information which I have witnessed and understood.(print name, sign & date-MM/DD/YYYY)

Witness: Robert Kuehler Date: 12/9/2004

Witness: Date: 12/9/2004